JOURNAL OF GAS LIGHTING, WATER SUPPLY, &c.

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EDITORIAL NOTES.

The Time-Honoured Wish.

AT the request of the postal authorities, in order to assist in relieving the pressure on their distribution system at Christmas time, the "JOURNAL" is published this week a day earlier than usual. It will consequently reach the greater number of our subscribers on the eve of the day of the great annual festival. This gives us the opportunity of expressing to them the time-honoured wish of "A Merry Christmas." The homely phrased sentiment has served for centuries, and has year after year, generation after generation, had its hearty expression in all parts of the world. Brief and simple though the sentiment is, it is expressive of much. All the mirth, happiness, and goodwill that are covered by the five-lettered adjective, we hope will be the portion of all readers of the "JOURNAL" and their friends—whether at home or over the seas.

An Amending Joint (Residuals) Bill.

IT is imperative that the mischief that was done to a number of gas undertakings in the still-unexpired session of Parliament by the curtailing of the residuals powers which the Legislature had already bestowed, should be undone at the earliest possible moment, in the face of the deliberate verdict that the Joint Committee of the two Houses of Parliament have given in favour of the gas industry, after full and keen discussion before them of the whole question. In the final paragraph of the editorial in last week's "JOURNAL" upon the victory of the industry—a victory which will dominate future legislation in this particular—it was suggested that a Bill should be jointly promoted in the approaching session of Parliament by those undertakings upon whom the restriction was imposed, and that, as a preliminary to such promotion, there should be a conference of representatives of the undertakings concerned. It appears from a communication received from Messrs. R. W. Cooper and Sons, the Parliamentary Agents for the gas industry in the contest before the Joint Committee, that, by the time the suggestion was made public in our columns, steps had already been taken to the end in view. Such prompt action deserves a prompt expression of support by those immediately interested; and therefore we have pleasure in giving the utmost prominence to the definite step that has been taken in the matter, in order that there may not be, through inadvertence or oversight, a single gas company or gas-supplying local authority unrepresented in the Joint Bill in whose Act or Provisional Order the obnoxious restriction at present appears.

The first step is a conference of representatives of such undertakings; and this conference must be held as early as possible. The date and time that the prime movers have fixed upon for the conference is Thursday, Jan. 9, at 2.30. The place of meeting will be the Westminster Palace Hotel; and Mr. H. E. Jones, the Chairman of the Gas Companies' Protection Association, will preside. If, by any chance, an invitation has not been received by any gas undertaking concerned, we are asked to state that this notification may be taken as an invitation to a representative or representatives of such undertaking to be present. Let it be added, too, that attendance at the conference itself will not involve any undertaking in any expense, nor will it commit any undertaking to participate in the promotion of a Joint Bill, until the Board or Committee have determined to take that course. It is not, however, a matter that can be left indefinitely in abeyance. The preliminary steps must be followed up with alacrity; and it is better that the time for securing amendment should not be deferred. In the Joint Committee's report, there is, as we said last week, all the inducement to the undertakings involved in the error of the session to take immediate action. The Houses of Parliament placed in the hands of the Joint Committee the duty of thoroughly considering the matter, in order to guide them to do what was right and just in regard to it. There is no local or other question involved that can raise controversy; the Bill will simply be to restore rights within the lines of the Joint Committee's decision. To this, Parliament itself cannot raise any objection, with the verdict of their own specially appointed Committee before them. We hope the representation at the conference will be complete, and that the name of not a single undertaking with the residuals limitation of the session upon them will be absent from the list of promoters. To adjust the wrong is, in this instance, a very simple matter; but it can only be done in one way, and that is through an Act of Parliament.

Essential Appendices to the Calorimeter.

A CONTRIBUTION to our pages this week from the pen of Mr. Jacques Abady raises questions of considerable importance affecting completeness and efficiency in gas-testing on the works with the view of studying the best interests of both undertaking and consumer. The time is opportune for the discussion of the matters which he introduces, in view of the fact that already in the case of two gas undertakings there has been supersession of the statutory illuminating power standard by a calorific power one, and in the case of the premier concern a calorific power standard is supplementary to the illuminating power one. With an eye especially on the interests of gas consumers, Mr. Abady is not at all assured that between the works and the consumer the calorimeter, standing alone, sufficiently safeguards the interests of the latter. But in expressing a qualified agreement with him, we should like to preface it by pointing out that, for all purposes for which gas is used now, calorific power is of vital importance; for one purpose, that of lighting, calorific power, composition, and specific gravity, are all of important consideration. Yet we must have present in mind, in order not to let our enthusiasm for control testing run us past rationality and practicability, that to-day there are only three gas undertakings in this country that are subject to a calorific power standard; and that all the others are still under an illuminating power standard. Further that in many of the works of the latter a calorimeter is not to be found; and that in the works in which calorimetric tests are made, only the larger concerns, with a laboratory and chemist in charge, make the complete tests which are supplementary to the calorific power one. What under these conditions is the practical experience? That there are comparatively few complaints on the part of consumers to-day regarding the heating value of gas, or of want of uniformity in the heating value, unless it be on the occasions of extreme production pressure owing to emergency demand. It is well to bear practical experience in mind in considering the questions that Mr. Abady raises, and raises in such a way, and with such cogent argument, that one is bound in the main to agree with him.

It is not suggested by our contributor that a calorific power standard should not supersede the illuminating power one; it is far from his thoughts to suggest that any test for the luminosity of gas *per se* is of standard value to-day, though photometry must always have a field in the scientific and commercial evaluation of lights of different character, and obtained by different means. But we are to-day dealing with gas that is sold chiefly for its heating property. This is the property upon which the future commercial value of gas must rest; and it is the property which must supply us with the standard of value for the consumer. Mr. Abady uses more than once the term "calorific standard" in his argument for tests supplementary to the calorimetric one. "It is my opinion," he says in one place, "that the "calorific standard, *per se*, is both incomplete and misleading;" and he also speaks of the grave mistake that gas manufacturers will make if they fix upon, or acquiesce in,

the adoption of calorific power as the sole "standard." Now it would be just as well if we at once ascertain from Mr. Abady whether his contention is that the legislative calorific standard requires supplementing, or whether he merely suggests that supplementary tests are necessary by gas makers as part of the routine of gas manufacture, in order to supply the best possible commodity to the consumers. We hardly know which line our contributor is prepared to take in this respect; seeing that he indicates very clearly his view that "the mere statement of the gross or the net calorific power "of a gas does not convey to the gas maker, and certainly "does not to the gas consumer, the complete value of "such gas." If it be that he would have the statutory calorific standard supplemented by compulsory and—in order to get to ultimate value—necessary tests, then we should be inclined, as we view the matter at the moment, to oppose the proposal, as the less complicated we keep the prescribed legislative standard, the more we keep it free from laboratory embroidery, the better for the gas industry. But from the practical side, as works tests necessary to the perfecting of the calorific standard, there is not, in the interests of gas manufacture and consumers, any one thing that Mr. Abady advocates that should be left undone. There we recognize the weakness of our position, as it is one of the drawbacks in industrial life that there are always a number in administrative authority who will not do certain things, however essential to efficiency, unless compulsion is brought to bear. But we must have consideration for the undertakings that have limited scope for close scientific control; and we must also have regard for the fact, when considering our statutory standards, that the industry finds that the less it is shackled by prescription, the better for its comfort and its commercial progress and trading conveniences.

As indicated, however, there is perfect harmony with our contributor in his contention as to quality for practical purposes depending on more than the bare readings of the calorimeter. To the calorimeter there are supplementary guides to quality—to a quality that has greater intrinsic bearing in the direction of incandescent lighting than in any other. Regarded so, calorific power alone will not guide to the selection of coal or to the best method of carbonizing it for gas making for town purposes. Now, especially if there is a low calorific power standard, and the coal produces a gas which leads to dilution with inert gases for the purpose of bringing down the calorific quality and enlarging gas volume, will the calorimeter be any real indicator as to the value of the gas to the consumer for lighting purposes? "I think it is quite a conservative thing to say," remarks the writer of the article, "that the inert constituents—es- "pecially nitrogen—affect the flame temperature to a greater "degree than they do either the illuminating power as "measured in the No. 2 'Metropolitan' burner or the "calorific power as measured in the calorimeter." M. André Grebel has discussed this very point, in his interesting suggestion as to the adoption of a new measurement—"comburimetry," which is briefly the determination of the amount of air required for the combustion of gas. Two gases having equal calorific power, but unequal compositions, may require a different proportion of air for complete combustion, and therefore the introduction of varied quantities of carbon dioxide and nitrogen, which varied volumes affect flame temperature. This is well known; but it is at the very root of Mr. Abady's contention for tests auxiliary to the calorific power one, in order to control the industry's primary product of coal carbonization.

As to the nature of these supplementary tests, most of them are carried out now in the larger undertakings; but in some cases there is the evidence of perfunctory or careless performance, or the application of unreliable methods. The collected data included in the article indicate that there are existing these vitiating conditions; it is also found from published data that tests most important to working and quality efficiency are apparently totally neglected on some works. For instance, there are works in which the specific gravity of the gas is never taken; and yet this is a very simple and handy index to the percentage of carbon dioxide and nitrogen in the gas, though, of course, with an increase in calorific power, there should also be an increase in specific gravity. Supplementary to the calorific power test, to put the matter briefly, Mr. Abady would have in the interests of working and quality efficiency, the net calorific value as well as the gross in order to furnish a guide as to the percentage of hydrogen, the specific gravity continuously recorded, a complete analysis made of the gas, as well as a determination of the carbon density of the unsaturated hydrocarbons. He advocates, too, the working of a continuous specific gravity indicator side by side with a calorific power recorder. These are the supplements that he would make to the calorimetric test, so as to ensure thorough control and the maintenance of the highest working results in respect of quality, to the advantage of both suppliers and purchasers. It is all excellent; and the arguments adduced in the article are in this respect incontrovertible. There may be some who will, upon superficial consideration, write much of it down as being beyond practical necessity. We should not be with them in this. Gas makers have a responsibility to themselves and their consumers; and though no one wants to be bound down by statutory strings to do what one should do in one's own interests, the facts of responsibility and of necessity remain.

For the performance of what he advocates, Mr. Abady introduces to notice the apparatus he would recommend; but he acknowledges that, in doing this, he is likely to lay himself open to certain criticism on the score of personal interest. He cannot help the circumstance of his individual position; but he can from this very circumstance speak with authority on many matters to which the intellect of the specialist must of necessity be brought. We may not all be in agreement with everything that our contributor says as to the apparatus, nor with the indirect indication of fault in other forms; and there may be calorimetrists and chemists who will be prepared to cross swords with Mr. Abady. What he submits is open, and is therefore exposed to criticism. This part of the paper does not concern us so much as the more general question treated upon in the opening section of the article. But those who think deeply on the first part, and who are not already practising what Mr. Abady preaches, will naturally and carefully consider the contents of the second part. One piece of apparatus that is new in its intended use may have attention particularly directed to it. It is the Simmance-Abady calorimeter, in which the "total" heat value of a gas is ascertained instead of the gross value. But Mr. Abady does not veil the fact that he, like many other experts in this matter, considers the difference between total and gross value of no material importance; but as it is an academic view in America that means of ascertaining the total heating value of a gas should be available, though America stands firm for gross value in standard prescriptions, a calorimeter for the purpose has been designed. There is much in the article before us; more than can be treated upon in the space of an editorial article. What has been said here, however, shows that there is considerable food for thought in this communication on a subject of immense importance to-day, but too little discussed in the technical circles of the British gas industry.

Leeds University Lectures.

CORDIALLY and sincerely, we congratulate Professor John W. Cobb, the occupant of the Livesey Chair at the Leeds University, on the comprehensive arrangements that have been concluded for a course of lectures by acknowledged authorities in connection with the Department of Coal Gas and Fuel Industries. As a print of the syllabus of the lectures is read, we cannot help feeling that, with such men as lecturers and with subjects of such current and future importance, no one upon the technical staffs of gas undertakings, who can conveniently attend the lectures, ought to miss them. Students of the affairs of the gas industry are not confined to young men in their teens; and we hazard the opinion, with a great deal of confidence, that no contradiction will be forthcoming to the assertion that there is not any man in high responsible position who will say that he knows all that the specialists in the various branches of the industry's work can tell him. Any man in the gas industry who could conscientiously say so, and who proved that his word in this respect deserved credence, would be worthy of the highest distinctions that could be conferred upon him. Therefore, the student and official area occupied by those to whom the lectures appeal is an extensive one. Time and duties are important factors in preventing attendance at such lectures; but we do hope that there will be special effort to take the largest possible advantage of the excellent provision that has been made.

The syllabus is reproduced *in extenso* in our "Miscel-"laneous News" columns. It will be seen from it that the lectures have a continuity from distribution to photometry. Mr. Walter Hole will supply the introductory lectures on

distribution; and he will go beyond distribution into utilization by treating of high-pressure lighting and the hygiene of lighting gas in competition. Then the combustion and structure of flames will be handled by Professor Cobb and Professor Smithells. Mr. E. W. Smith, M.Sc., will follow with lectures on gas heating, gas-fires, and high-pressure gas. Finally, Mr. Jacques Abady will lecture on gas lighting and photometry. The course will comprise twenty lectures in all, and extend over three months. The fee for the course is very moderate. For those interested in bye-product coking processes, a series of lectures on the subject has also been arranged for Saturday afternoons; these being in the hands of Dr. M. G. Christie and Mr. W. Greaves.

We do not think there is any need to emphasize the value, both to young engineers and their employers, of such lectures as those outlined in the syllabus. All the knowledge imbibed by members of gas-works staffs is of value not only to themselves but to the undertakings they serve. They cannot help making use of their knowledge in their work. Therefore there can be no question as to the desirability of employers granting facilities to the members of their staffs for obtaining the advantage of attendance at the lectures. Employers in the gas industry should recognize that it is essential that, in the professional race, the gas industry should keep well in line with all other engineering branches. In these—and the importance has been emphasized by the Institution of Civil Engineers—training on a University standard, in addition to practical work, is coming to be more and more regarded as highly desirable for young men who are going to take up positions of responsibility. A like recognition in the gas industry would not be to its future disadvantage nor to that of the gas profession. The Leeds University has provided the means to a recognized desirable end; and it is for the gas industry to make the utmost possible use of the means.

Economizing Heat.

THE series of three Cantor Lectures at the Royal Society of Arts, by Mr. Charles R. Darling, F.I.C., has been brought to a close with a contribution to the subject of domestic heating. The title chosen for the lectures was "Methods "of Economizing Heat;" and Mr. Darling brought into the composition of his deliverances a considerable amount of interesting and useful material relating thereto. The general subject is one of extreme importance to our national life, as the economizing of heat means the economizing of fuel; and the realizing of the maximum value from the fuel used in domestic and industrial heating is both a highly worthy ambition and achievement. Probably there is no direction in which more rapid changes for the better have been made than in our modes of heating. The last few years have seen immense activity in this direction. It was but a few years ago that workshop practice included the crudest modes of utilizing solid fuel. This has been largely changed, with benefit both to the manufacturer and to his productions. In many cases, too, the solid fuel has given place to the gaseous form—low-pressure, high-pressure, and low-pressure with air-blast. The domestic hearth has also undergone amazing change. The old forms of fire-grate seem as we look at them from the standpoint of knowledge to-day to be simply constructed to act as fuel containers, without much thought as to fuel economy or heating efficiency. Such grates have had their day. The imprints of science are upon all the modern means of heating by solid fuel. The same with the gas-fire—the fire that is so keenly and successfully contesting for a very considerable place in domestic heating, as a convenient, sanitary, and economical means, that the makers of solid-fuel grates have bestirred themselves to meet the competition, in which they are handicapped by the gas-fire being a labour-saving appliance, creating no dust or smoke, having a convenience in use that no solid fuel fire can have, and demanding no prior purchase or storage of coal. The same applies to the kitchen range. It is only by the generosity of architects and builders that the makers of solid fuel kitchen ranges have retained at all this section of their business. At the same time, landlords have something for which to be thankful to gas undertakings in that their provision of gas-ovens and gas-boiling conveniences have lessened the wear and tear upon the ordinary kitchen range. The same thing applies to steam raising and to domestic water heating—there has been development in economy and efficiency all along the line. All this by the way, however. Progress is seen in all our methods of obtaining heat, excepting where any change, such as in the case of the electric radiator, has produced heating inefficiency at a much greater cost than by other modes. Such a system of heating cannot come under the designation of Mr. Darling's lectures, "Methods of Econo-"mizing Heat," seeing how expensive are the B.Th.U. produced electrically. As a matter of fact, he did not have much to say on the subject of the electric-radiator, save to show that it has narrow limitations, is the most costly means of heating, and is less hygienic than solid fuel or gas-fires on account of the fact that it does not contribute to ventilation. In short, the electric radiator may be dismissed from thought as a serious competitor of the gas-fire, except for special situations.

The relative positions of the other systems of heating are generally fairly described by Mr. Darling, though doubtless the specialist advocate of any one system could show him various advantages that he has either overlooked or did not have time to mention in his series of lectures. He gives to coal and coke the superior place in point of radiation; and the gas-fire has to take second place. In fact, he describes coal and coke fires as being nearly perfect radiators, and the greater perfection over the gas-fire is attributed to their higher temperature. But there does not seem any reason why, in view of the temperatures that are now obtained in low-pressure gas-furnaces, there should not in time be improvements and changes investing the gas-fire with degrees of temperature equal to those of the incandescent coal or coke fire. But when "nearly perfect radiation" is spoken of, Mr. Darling ought not to omit notice of the point that neither the temperature nor the radiations of the coal fire are constant, owing to the different conditions of the fire right away from the replenishing with fuel to the time when replenishing is again demanded. There is a constant zig-zag line of temperature in every solid fuel domestic fire—gradually ascending to maximum, and then descending; and so the progressive actions up and down continue the day through. On the other hand the temperatures and radiations of the gas-fire can be maintained hour after hour at a constant level; and we submit that this is an excellent and acceptable set-off against any margin of superiority in radiation that the solid fuel fire can claim. This point as to the regularity of the gas-fire, together with those of convenience, rapid ignition and extinction, and no stand-by costs, must be taken into account in considering relative expenses. Mr. Darling takes the cost of putting into a room a proportion of the heat units of combustion; and while on this basis gas comes out somewhat more than the coal or coke fire, this cannot be regarded as presenting any fair, real, or reliable contrast. The conditions surrounding the realization of the basis adopted for the comparison are altogether dissimilar, and must be taken into account. Mr. Darling's basis is just about as reasonable as would be the ignoring of the time-factor in obtaining hot water, starting the apparatus cold, and with the water at equal initial temperature, by means of the ordinary kitchen coal range, and of a domestic gas-heated circulating boiler.

Let it not be imagined that Mr. Darling is speaking in favour of the coal and coke fire to the detriment of the gas-fire. He points out the disadvantages of the coal fire, as well as its advantages. He does the same with the gas-fire. But—perhaps this is only natural on our part—we do not think that he took such a wide view of some points to the advantage of the gas-fire as he might have done. Another matter to which he drew attention was the greater ventilation with the coal-fire than with the gas-fire. "The "amount of air drawn up the chimney," said the lecturer, "was not nearly so great with the gas-fire as with the coal-"fire." It is patent that Mr. Darling is, like Dr. Leonard Hill and other authorities on the subject, a great believer in the hygienic benefit of the domestic chimney, and the effect it has in producing a change in the air of rooms. But he seems to regard the greater inductive power of the coal-fire as being an advantage in the matter of ventilation over the lower pull of the gas-fire. It is not a question of volume so much as of what is necessary. The lower chimney flow effected by the gas-fire may be more than abundant for all sanitary purposes; and we know, from the experimental work carried out in this regard, that it is so. Therefore, the higher chimney flow produced by the coal-fire is not necessary to a healthful condition of the atmosphere, but is an essential both to the function of combustion and to the transmission of products of combustion which are weightier than in the case of the gas-fire.

There are other practical points in the lecture which

invite comment. Mr. Darling spoke of the "hum" of the bunsen burner, though admitting this was not a great objection. In the modern gas-fire with proper regulation and properly designed burners and nozzles, there is no occasion for any disturbing noise. Turning to the top-plate of the gas-oven, Mr. Darling's criticism of the boiling-ring is fully justified. In the larger forms, they are mostly constructed so that, with flat bottomed circular vessels, the body of the flame is at the periphery of the vessel and none in the centre where it is wanted; and thus there is great loss of heat from round the sides. The shape, too, of the boiling utensils used on the top-plate was referred to. We can agree entirely with Mr. Darling in his condemnation of the little attention that has been bestowed upon the design of appropriate vessels for use on gas-oven top-plates or with boiling-rings. Mr. Darling has found that there is a very material saving of gas when employing a kettle with bulging sides and small bottom, compared with a flat-bottomed one—the former construction allowing the flames to play on the sides of the kettle. With a kettle, such construction would be simple enough; but it would reduce the serviceability of saucepans for some purposes. There was one method of economizing heat on which work is now proceeding, and to which Mr. Darling does not appear to have referred. That is the utilization of the waste heat of gas-ovens for heating water for kitchen use. So far as experimental work has gone, it is found that a quantity of water can be heated by the waste heat of the gas-oven *plus* a small extra consumption of gas, which quantity of water would require much more gas to heat it if separately dealt with.

Joy, Dejection, and Darkness at Sheffield.

The House of Commons has looked with sympathetic eye upon the position in which the Sheffield Corporation find themselves in relation to their electric wiring and fittings business, and has stood by the decision of its own Committee, by brushing aside the amendments that the House of Lords made in the Bill in regard to this matter. The facts are briefly and simply these: Some fourteen years ago the Corporation took over, under parliamentary authority, the electricity supply undertaking from the then operating Company. To the undertaking was attached a branch department dealing with wiring and fittings. The Corporation carried on this department until the local contractors considered it was unfairly competing with them. Then came the Leicester decision, which declared that the Corporation of that town were acting *ultra vires* in the matter of dealing in wiring and fittings. Stimulated and supported by the success in that case, the Sheffield contractors considered the time opportune to put their own dispute with the Corporation to test by asking the Courts to determine whether or not the latter possessed the powers they claimed. The Courts decided that they had not; but against this pronouncement the Corporation have an appeal pending. Almost simultaneously with this movement, the Corporation promoted a Bill in Parliament, one section of which was to confirm them in the conduct of their electric wiring and fittings department—this being a second string to their bow in the event of any failure in the litigation. In the special circumstances of the case, the House of Commons Select Committee, presided over by Sir Henry Kimber, considered that they should be granted power to continue the department; but the House of Lords were averse to their engaging in the sale of fittings and in wiring and fitting work other than through the contractors—thus placing the business under the current model clause applying to this subsidiary trading.

The Corporation were consequently hit severely from two quarters. They rebelled against their fate, have been negotiating right and left to undo what the House of Lords had done, and they were prepared, metaphorically speaking, to move Heaven and earth to get unravelled the tangle in which they found themselves. They succeeded in moving Mr. Pointer, the Labour member for one of the divisions of Sheffield, to take compassion on them; and it is known that there has been much personal influence exercised to secure for the honourable member considerable support in the Commons when he moved the rejection of the Lords amendments. This he did last Tuesday evening; and, receiving the support of the House, the Bill is restored to its original form. Thus the model clause is violated; and the peculiar position of Sheffield is the only justification. An explanation has to be made to the House of Lords as to the grounds for this maltreatment of their decision, which, of course, overrode the former decision of the House of Commons. But if there were occurrences of this sort in connection with all Private Bills during a session, the work of Parliament would become more complex than ever, and Committees would be discouraged from giving of their best in judicially considering the measures referred to their investigation. There is naturally joy in the Corporation circle of Sheffield. The contractors are equally dejected; for the least they expected after their successes was a parliamentary injunction for conforming the conduct of the branch business to the rule of the model clause.

Almost simultaneously with the act of Parliament which restored the right to trade in competition with the electrical contractors, there was a failure of the electric supply in Sheffield, from a fault at the Neepsend generating station. The cessation of supply continued for about a quarter of an hour; but as ill-fortune would have it, inconvenience was intensified owing to Christmas shopping being in full swing. Those business establishments with a gas supply and those with gas-driven electricity generating plants counted themselves more fortunate than their rivals, who were rushing about for candles or night lights. The worst trouble was in the large emporiums that were crowded with customers, who made a speedy exit from the places (other than those where they were kept prisoners through the doors being locked, which is a questionable and risky proceeding on the part of a tradesman) when they found themselves suddenly in darkness. Work at the Post-Office and at the Town Hall was considerably delayed. The incident will no doubt cause many electricity-using shopkeepers in Sheffield to protect themselves against this sort of thing by re-installing gas. More and more business establishments are doing this in the Metropolis.

Christmas Time and Electrical Failures.

The electrical industry is particularly unfortunate in the time chosen for a display of the slight margin of safety there is in their case between supply and use. In an earlier column, reference is made to a collapse of the supply at Sheffield while tradesmen were reaping the heaviest harvest of the year; but a more serious affair is the fire and failure that occurred early on Thursday morning last at Salford, which reproduces with worse consequences for the customers (owing to the heaviness of the power load) the uncomfortable incidents recently at Islington and Ilford. The origin of the fire and of the protracted absence of electrical energy at Salford was a very simple one. It appears that a workman was engaged with a spanner at the back of the switchboard; the spanner slipped, also the man. A short-circuit, fire, and collapse of the electricity supply throughout the borough followed, with damage for the department to the extent of £10,000, included in which is a new switchboard, upon which £5000 had been spent. There are other losses, besides the inconvenience to the private consumers. Tramcars came to a standstill, as also works depending upon the electric current. Nearly 3000 workpeople, it is computed, were thrown out of employment, and there was no hope of resuming work during the week. Shops were busy owing to the nearness of Christmas; but, fortunately, comparatively few shops in Salford rely on electricity for lighting—the incandescent mantle affording them a cheap and brilliant light. Those shops that were electrically lighted suffered great inconvenience; and, on Thursday night, the Electrical Engineer still feared some 48 hours would elapse before private consumers and tradesmen could again have a full supply of energy. Not only were works depending on the electric drive placed out of action, but the cranes and hoists at the dock were brought to a standstill. The Manchester Corporation came to the rescue so far as the tramways were concerned; and through their neighbourly help, the cars were soon running again. We are sorry for those put to inconvenience, and regret the waste; but these affairs point a moral which is not to the disadvantage of the gas industry.

America and Calorific Power.

The Committee appointed by the American Gas Institute to consider various questions affecting the thermal value of gas reported at the recent annual meeting; and the principal portions of the report are presented in our columns to-day. We are glad to find that, despite influences to the contrary, the Committee—and it was a Committee the competence of which is not open to question—are desirous of keeping standard prescriptions for calorific

value on simple and uniform lines; and, if they succeed in doing this, they will be conferring benefit on the technical work of the gas industry at large, as the British standards and their own, and the conditions of the tests, will then be on a comparable basis. The Committee, as in this country and like the Metropolitan Gas Referees, are averse to adopting the net heating value for standards; and they adhere to the conditions of 60° Fahr. and 30 inches barometric pressure, as well as to the expression of thermal value in B.Th.U. per cubic foot. But they discuss at some length the views of Dr. Rosa on the subject of the "total heating value" of gas being ascertained, and suggest consideration being given to the devising of a calorimeter to determine total heating value. It will be seen towards the end of an editorial article in this issue on "Essential Appendices to the Calorimeter" that such a calorimeter is already in existence. We hope, however, that gross value will be maintained for standard tests. On previous occasions, there has been criticism in our columns of the obvious prepossession of the controlling authorities of America for high calorific standards, which are against practical and technical opinion and economic considerations. The Committee, at the end of their report, give reasons against this trend of action on the part of the Commissions, showing that it is opposed to both the interests of gas manufacture and consumers. They are right; and we hope to see the various regulating authorities come round to the same way of thinking.

Gas-Works Chemistry.

Comparatively few chemists have anything more than a nodding acquaintance with the operations and extent of the gas industry. Mr. W. J. A. Butterfield, M.A., F.I.C., has set to work to enlighten them in two lectures, on "Chemistry in Gas-Works," that he is delivering to the members and students of the Institute of Chemistry. In the first lecture, Mr. Butterfield did not get far into the chemical part of his subject; but he gave his audience information as to the commercial line along which the gas industry is working in meeting the need of the day—that is to say, in providing the consumer with the greatest number of B.Th.U. at the lowest possible cost—as well as particulars regarding the great expansion of the industry, and the development of its manufacturing processes. From the lecture several interesting and useful points may be picked—such as the estimate of the world's production of town gas for 1912. It will reach the grand volume of about 620,000 million cubic feet. The computed quantities of residuals produced in the world's gas undertakings are also quoted. The F.I.C.'s and the students present must have gathered from this presentment of the industry's magnitude that it furnishes a vast territory for the work of the chemist. But there are not so many gas-works with a chemist on the staff as we should like to see, although there are many junior chemists who would be glad enough to get the experience that even a moderate-sized gas-works could offer. Incidentally, we learn from Mr. Butterfield that London still leads the capital cities of the world in gas consumption *per capita* of the population. A manufacturing rule in regard to quality prescribed by the lecturer may be noted. He holds that, broadly speaking, fluctuations in a gas supply should not exceed 5 per cent. in calorific power, 5 per cent. in specific gravity, and in the proportion of oxygen required for the combustion of the gas 2 per cent.

Developing the Salesman and Gas Sales.

There are some wiseacres—fortunately their number is limited—who think the gas salesman does not require developing or is above assistance of any kind; that he is a walking repository of all possible knowledge useful to the cultivation of his business; and that it is idle for him to have the means of obtaining a larger knowledge of the relations existing between his own commodity and that of his competitors. If the gas industry was directed by these wiseacres—a five-lettered word would be a more apposite description—its commercial interests would be very quickly weakened by the successes of the spirited competitor. Highly developed as is commercial work in America, and not less in the gas business than in others, the President of the American Commercial Gas Association (Mr. C. L. Holman), in his Inaugural Address, lays great stress on the need there is for the material support of gas undertakings in furnishing means for facilitating the instruction of gas salesmen—indeed, Mr. Holman goes so far as to say "there is a crying need for the developing and training of the commercial man just as much as there is of the technical man." No one can dispute this when he considers the vital part that gas trading has to-day in the fortunes of the industry, and the nature of the competition that has to be met. The Association, it is noticed, have not yet developed a national advertising scheme. Conflicting opinions seem to be operating against the production of a concrete project; and there is at present a distinct leaning towards co-operating to the fullest possible extent with the local press rather than participating in general advertising. We are afraid that, in this country, the local papers, except in the case of the more prominent ones, are not so widely read as are the more general ones; while magazines of all classes here reach quarters in which little heed is paid to the local papers, with the exceptions already mentioned. Our American friends have no doubt noticed that the gas industry in this country believes in supplementing local advertising by general advertising, and advertising in the professional papers—medical, architectural, and so forth—where the announcements will meet the eyes of men and women of influence. We shall be interested in seeing what, if anything, is evolved from the present antagonistic opinion on the subject among American gas undertakings.

PERSONAL.

Mr. CHARLES DURRANT has been appointed Manager of the Isle of Wight Water Company, in succession to his brother, whose death was recently announced in the "JOURNAL," and whom he had materially assisted for many years.

The Directors of the Southam Gas Company have appointed Mr. MARK TAYLOR, at present Works Manager at the Padstow Gas-Works, to fill a similar position at Southam, in place of his father, the late Mr. Mark Taylor. There were about forty applications for the post.

The Yeovil Corporation Gas Committee have appointed Mr. FENWICK (who is the son of Mr. J. B. Fenwick, Manager of the East Retford Gas-Works) as Assistant to Mr. Edward Howell, their Secretary and Manager, in place of Mr. H. D. Lumb, who, as already announced, has gone to Chard.

Mr. H. HOY, the Assistant Gas Manager to the Lancaster Corporation, has relinquished the position on being appointed Gas and Water Engineer to the Tyldesley Urban District Council, in succession to Mr. H. R. S. Williams, who, as already announced in the "JOURNAL," has gone to Altrincham. The Gas Committee, in accepting Mr. Hoy's resignation, expressed the hope that he might be successful in his new post.

At last Wednesday's meeting of the Gas Committee of the Macclesfield Corporation, the resignation of Mr. WILLIAM NEWBIGGING as Gas Engineer was accepted with much regret. It was stated that the Newbigging family had been associated with the Macclesfield Gas-Works for a great many years; the present Engineer being the third of the family to hold the position. We understand it is Mr. Newbigging's intention to devote himself more fully to consultation work.

OBITUARY.

The death occurred on the 16th inst., at his residence at Higher Crumpsall, Manchester, of Mr. ALBERT MANNING, who was for fifteen years Secretary of Meters Limited. Mr. Manning had been ailing for some time. He was in his fifty-first year.

The death took place suddenly on Saturday, the 14th inst., of Mr. R. L. DEANS, Gas Manager, of Johnstone. A native of Paisley, he went to Johnstone over thirty years ago as an inspector of meters; and in the course of a few years he rose to the head of his department. During his managership, large additions have been made to the undertaking; and at present the Council are carrying out, at a cost of £15,000, further extensions, which were being superintended by Mr. Deans.

The residents in the Low Moor (Yorks.) district were much affected when it became known that the death had suddenly occurred of Mr. EPHRAIM SUCKSMITH, who was formerly Secretary to the Low Moor Gas Company, whose undertaking was acquired some years ago by the Bradford Corporation. The deceased was 66 years of age, and last Sunday week he was sitting at home reading, when he suddenly collapsed and expired, in the presence of his wife and daughter, before medical aid could be summoned. Death was attributed to heart failure.

Mr. HUGH PURDY, one of the oldest gas inspectors in the employ of the Manchester Corporation, died under tragic circumstances on the 16th inst. While travelling by tram car from Moston, where he resided, to business, he was seized with illness, and on his removal to the Royal Infirmary he was pronounced to be dead. He had been in the service of the Gas Department for upwards of forty years, and would have celebrated the sixty-first anniversary of his birthday on the day following his death, which, at the inquest, was stated to have been due to heart failure.

THE DECISION OF THE JOINT COMMITTEE ON RESIDUAL PRODUCTS.

A Conference and an Amending Joint Bill.

It appears that the suggestion contained in the concluding words of our editorial in last week's issue upon the report of the Joint Committee on the question of restricted residuals powers had already been anticipated by some of the companies upon whom the limitation had been imposed. This will be seen from the subjoined letter, in which intimation is given of the convening of a meeting to consider the matter of the promotion of a joint amending Bill. The letter (upon which comment is made in our eader columns) has been sent to the promoters of this session's Bills and Orders in which the restriction was inserted.

5, *Victoria Street, London, S.W.*
Dec. 17, 1912.

GAS AUTHORITIES (RESIDUAL PRODUCTS).

Dear Sir,—Having regard to the decision given by the Joint Committee of both Houses of Parliament, appointed to consider this matter (a copy of whose report we enclose herewith), some of the gas companies upon whom, in the present session of Parliament, a restriction was imposed, which prevents them from "dealing in" residual products, contemplate promoting a Joint Bill in the ensuing session for the removal of such restriction.

A meeting, under the presidency of Mr. H. E. Jones, Chairman of the Gas Companies' Protection Association, will be held at the Westminster Palace Hotel on Thursday, the 9th of January prox., at 2.30 o'clock in the afternoon, to consider the matter; and we are instructed to invite attendance thereat of a representative or representatives of your undertaking.

Attendance at this meeting will not involve your undertaking in any expense, nor in any way commit it to join in the proposed Bill.

Yours faithfully,
(Signed) R. W. Cooper & Sons.

A Little Knowledge ——

The "Electrical Times," referring to the Joint Committee's decision, says:

Rarely does an award find jubilant acceptance by all the contending parties, yet both the Gas Press and the chemical manufacturers express complete satisfaction with the decision of the Joint Committee of the House of Lords and the House of Commons on Residual Products. It will be remembered that the gas authorities have found sources of high profit in the conversion of their residuals into marketable chemicals. So much so that they have gone into the open market and purchased residuals to work up in addition to their own bye-products. Although certain chemical manufacturers subscribe heavily to the doctrine of Free Trade as applied to other people's businesses, free trade in residuals brought them into strenuous opposition to the practice; and they succeeded in securing the appointment of the Committee mentioned. The award declares against free trade in residuals, and puts a limit to the activities of the gas undertakers by proscribing the purchase by gas interests of materials in the open market from sources other than gas undertakings. This decision, it is gathered, gives all to the chemical manufacturers that they wanted, and if the tone of the Gas Press affords any criterion, the gas industry is equally contented.

The friendly tone of the foregoing makes the more amusing the distance that the writer of the paragraph is from the actual facts. We should be pleased if our contemporary would direct our attention to the expressions that he is supposed to have seen of complete satisfaction with the decision on the part of the chemical manufacturers. What they asked for was that gas undertakings should be prohibited from purchasing raw residual products from each other; and the Joint Committee do not, on consideration of the whole of the facts placed before them, see their way to comply, and to constitute the chemical manufacturers the sole markets for the liquid residuals and the spent oxide, nor do they see any reason why one gas undertaking should be prevented from helping its neighbours, nor from having recourse to the coke, tar, and other residuals surpluses of neighbours when they want to supplement their own production to meet contract and retail demands. It was not the chemical trade who secured the appointment of the Joint Committee, but the gas industry, in view of the injustice that had been done to certain undertakings this session in imposing upon them restriction which prevented them purchasing residuals from their neighbours. We do not know of any gas undertaking that has bought residuals from any other source than a gas undertaking; and of this liberty the chemical manufacturers tried to deprive them. We cannot therefore see how the decision "gives all to the chemical manufacturers that they wanted."

The "Chemical Trade Journal" on the Report.

The following editorial comments on the Joint Committee's report and decision appear in the current issue of the "Chemical Trade Journal."

Chemical manufacturers will be disappointed with the report of the Joint Committee of Lords and Commons on the question of restricting gas undertakings in the disposal of their residual products. The recommendations of the Committee practically restore the conditions which existed prior to the insertion of the restrictive model clause upon the petition of the chemical manufacturers into several Gas Bills this year. The Committee agree, however, that the gas undertakings should not be allowed to purchase raw materials bought from any other sources than gas undertakings, and also that they would be opposed to the gas undertakings entering into the ordinary business of chemical manufacturing. Although the chemical manufacturers have not succeeded in getting a favourable decision upon the main point at issue, the above expression of opinion by the Joint Committee goes a long way to justify the attitude taken up by the chemical manufacturers. It was not so much what had been done in the past as what they feared in the future regarding the developments that were foreshadowed by gas undertakings in entering into the general business of chemical manufacturing, aided by their more favoured position. The Committee did not express an opinion on this point, but merely contented themselves in saying that it could be better dealt with as it arose. This means that the struggle would probably be renewed at some future date if the gas undertaking show signs of extending their operations. We think that the Committee have stated this aspect of the case rather unfairly to the chemical manufacturers. It was not suggested that the gas undertakings would make chemical manufacturing their more important business—such a contention is obviously impossible; but it is quite within the bounds of possibility that they could make the business of chemical manufacturing so important that the outside chemical manufacturers would be crushed out of existence. Although this state of affairs might come in time, it is not to be expected that it will be accepted by the chemical manufacturers without protest. The gas industry owes much to the outside chemical firms for their pioneer work in dealing with gas residual products.

The foregoing comments are not of a character that call for any extensive criticism. Objection may be taken to the term "restrictive *model* clause." The clause was neither "model" in nature nor in form. When it was inserted in the Acts and Provisional Orders of the session, it was altogether out of harmony with the "model" clause issued for the Bills and Orders promoted in the session of 1912. Naturally, the chemical manufacturers do not like the reversal of their position; for what it amounts to is that their campaign has been, on the real point of contention, entirely abortive. The direction in which the gas industry is told they must not trespass in future is one in which it has never contemplated going—that is to say, into the business of purchasing and working up raw materials produced outside those that are the direct result of the carbonization of coal for the manufacture of town gas. At the same time, the gas industry—also naturally—did not like the success the aggressive chemical manufacturers first scored, and which has now been proved to have been an unjustifiable success. The result of proper investigation has also shown that the chemical manufacturers cannot produce a shred of justification for having put the gas industry to the expense that they have done, as well as wasted much valuable time, in prosecuting this campaign on "fears" only, without anything in the nature of substance. Our contemporary points to the purchase by gas undertakings of raw materials from each other as "the main point at issue." It is not easy to reconcile this description with the succeeding words: "It was not so much what had been done in the past as what they *feared in the future* regarding the developments that were foreshadowed by gas undertakings [where foreshadowed?] in entering into the general business of chemical manufacturing." If our contemporary's comments represent the best that can be said for the case and position of the chemical manufacturers, then the members of the Joint Committee will find in the comments full endorsement of the justice of their decision. It is plain that the gas industry and Parliament have been the victims during the session of several strange delusions on the part of the chemical manufacturers

The following remarks on the residuals question appeared recently in the Engineering Supplement to "The Times:" "Now that the inquiry by the Joint Committee concerning what restrictions, if any, should be placed upon gas authorities in the manufacture and working up of residuals is concluded, the general effect of interference by the State with the natural development of industrial processes of benefit to the community is more clearly understood, and a rational decision by Parliament on the question may be expected. . . . The main point at issue arises from the sulphuric acid industry. It was contended that the gas companies were likely to oust the manufacturers of anhydrous ammonia; and there is a complaint that gas companies are already tendering for the supply of sulphuric acid; and that they may ultimately ruin the business of other manufacturers by forcing them to lower their prices. On the other hand, it is held that in many instances the gas companies have plenary powers to deal in residuals, and that they have the right to trade between themselves in the products of their industry. In the case of municipal gas undertakings, there may be need for restrictions to safeguard the public money; but in the case of private companies conforming with local regulations affecting public health and comfort, it is difficult to assign a good reason for imposing a check upon such an enterprise. With the advance of scientific methods, and with improvements in machinery and plant, the waste of yesterday, when properly treated, yields the valuable bye-product of to-day; and to legislate with the object of imposing restraints upon the sale of these products would be to put this country at disadvantage in competing against the world. If it can be shown that any undue favour has been granted to gas companies whereby injustice is likely to be done in the course of new business, to the injury of existing firms, the occasion would be opportune for adjusting the matter. The essential requirement is, however, that there shall be freedom for gas companies to give the home industries the benefit of the cheapest bye-products they can turn out upon equable terms."

ELECTRICITY SUPPLY MEMORANDA.

The Shrinkage Fiction—Facts from the B.C.G.A.—Deceptive Message of a Title—Causes of Commercial Backwardness—The Useful Wily Canvasser—Protection of the British Museum—Gas Companies as Electricity Suppliers—Hove's Proposed Purchase.

THE top note in the campaign to popularize electric cooking is the shrinkage fiction. Most makers of electric cooking appliances sound it in the public ear. The "Tricity" people are particularly strong in its use; but they exercise that use with a degree of caution that shows consummate cleverness, and a fine appreciation of the value of having someone else for a shield. They have chosen that aged domestic tome Mrs. Beeton's cookery book as their shelter and authority, so that they can always bravely fall back on the answer to critics who press them: "*We* did not say it was true; Mrs. Beeton says it." We have referred to this act of commercial wisdom and chivalry before; but it is just as well to keep it to the front until we can get these people to mend their ways, or else take the bolder course than their present tactics, of having a public side-to-side demonstration with representatives of the gas industry of the relative merits and demerits of the two systems of cooking. What Mrs. Beeton may have said in times past on this subject of shrinkage in meat baking has—and the electric cooking exponents know it—no real bearing on the actual conditions of to-day; the lady's ideas, too, as to the degree to which meat should be baked may have no likeness to the views of the electric cooking advocates, who have a strong preference for underdone meat. We never heard of anything more absurd than this shrinkage fiction in connection with the commercial exploitation of any article of domestic utility, save in the case of those goods that are exploited by the cheap-jack class of vendor. But the shrinkage contention is, as one of our electrical contemporaries would put it, a sort of "last ditch" for the electric cooking advocates. In cost, time, and all boiling operations they are completely out of the running with gas; and so there must be reliance on fiction—and cheap fiction too.

Lately, as readers of the "Memoranda" are aware, the Tricity people were blowing loudly on their publicity horn; and then the Company owning the Tricity patents came out to the public to ask for more capital. There were preliminary newspaper puffs regarding the virtues of the Tricity cooker, the usual references to the modest shrinkage by baking meat in the electric cooker, as well as the views of the estimable Mrs. Beeton as to the amount of shrinkage that a well and properly cooked joint should show when treated in the gas-oven. Of course, on consideration, the intelligent public will want to know why, if one joint is cooked to an equal extent to another of similar weight and character, it should show an unequal amount of shrinkage. The public will be told, in reply, that this is an electric cooking phenomenon first observed owing to pressing commercial needs, and that it has not yet been adequately investigated. Among the papers that gave the recent Tricity demonstration publicity was the "Financial Times," and its paragraph contained the grey-with-age opinion of the lady already mentioned. The British Commercial Gas Association, in reply, called the attention of our financial contemporary to particulars of actual tests that have been made (without the aid of Mrs. Beeton), which absolutely disprove the advertised shrinkage fiction of the electrical people; and what is more the Association offer to have the comparative tests repeated for the benefit of any interested persons. Nothing could be fairer. The particulars quoted are: Two legs of lamb, each weighing 76 oz. before cooking, were baked, one by electricity and the other by gas. The net loss of weight in the case of the joint cooked electrically was 11·2 per cent. In the case of that cooked by gas it was 9·3 per cent. The cost for electricity (at 1d. per unit) was 2d., as compared with 0·42d. for gas (at 2s. 6d. per 1000 cubic feet). Are the electricians prepared to say this is a false statement? Remember before replying that the Association are ready at any time to have the tests repeated for interested persons.

Touching this subject of the use of electricity for baking, there is before us a large extract from the "Rochdale Observer," in which a great display is made of the use of electricity in the bakery of "Henry Whittle, Limited," at Loughborough. The display is headed "Baking by Electricity," but we found that the heading is not in accord with truth. The matter that succeeds the heading describes the plant in the firm's bakery, which includes a kneader and other appliances used in the preparation of bread, and which here are operated by electric power. There are also six ovens; but the article does not state the means by which the ovens are heated. The title of the article "Baking by Electricity" caused inquiries to be made; and far from these words conveying the truth, the firm inform us that the ovens are heated by coke. Was the message of the large capital heading intended to deceive the public?

A couple of articles have appeared in the "Electrical Review" on "The Commercial Development of Electricity Supply;" and after reading these, the impressions left on our mind are of various order. They are anonymous articles. Whatever, therefore, are the qualifications of the writer for sitting in judgment upon the electricity industry and counselling it we do not know, other than the measure of truth we find in a disinterested assessment of the word-bedecked contributions. The articles must have stirred the very souls of the responsible men of the electrical industry in divers ways. Judgment is heavy. The industry is defective in its constitution; commercially it seems to be directed by a lot of numskulls; and the capacity for falsehood is not unknown. Those are impressions left after perusing the articles. On the other hand, there is enough said about the British Commercial Gas Association, its President (Mr. Corbet Woodall), and the Executive Committee and machinery, to make the *personnel* of the organization blush in the most visible part of the anatomy of the individuals. On the other hand, the electrical industry is held back from effective co-operation and co-ordination of its parts, to a very large extent, by municipal control—"municipal undertakings which are nominally controlled by a misfit imitation of a board of directors." This is one of several scintillating gems in the articles which indicate where fault lies in the structural efficiency of the industry for good commercial work. The "embryo chief engineer," the "clerical hacks," and the "wily canvasser" are spoken of; and the engineers of the industry are not shown to have reached any high pinnacle of fame for commercial ability. The literary quality of the articles may be judged by the following pregnant, if flowery, excerpt: "Lack of expansion may also be attributed to the attitude adopted in some quarters whereby electricity supply undertakings have been regarded as the monopoly of professional men, who, by strict observance of the rules of hide-bound etiquette and tradition, have preserved their escutcheon unsullied by cold-blooded commercialism. Such an academic attitude is quite appropriate in the case of the occupant of a professorial chair at a university, but in the business world the position is untenable." The technical man of the electricity industry will see from this the limitations from which he is suffering as a useful unit in the world's affairs; and he had better at once help "to adjust various myopic and astigmatic defects existing in administrative vision, so that the position may be viewed in true perspective."

While not presuming to say that the articles, so far as reference to them has gone, do not show good judgment and sense irrespective of the mode of expression, there are other points with which we are in complete agreement. Of course, we can afford to overlook the natural view of an electrical partizan that electric heating and cooking apparatus is now seriously assailing the supremacy of gas apparatus. Then we are brought into contact in the articles with what is described as that "useful individual" in the electricity undertaking—the "wily canvasser." He appears to be an invaluable person who circulates falsehoods, and is made and paid to be the scapegoat of the concern. We gather this from a statement far removed in the articles from the descriptive term "wily." Of this useful member of the staff, we read: "It is radically wrong to compel him to make himself an unmitigated nuisance in order to obtain business. Misrepresentation of facts is also condoned should an application be thereby obtained; and on receipt of complaints from the subsequent consumer, apologies are offered from headquarters pointing out that the man is only a canvasser." This is a serviceable sidelight on the commercial methods of our friends of the electrical industry. We once heard of a bishop who, desirous (with his chaplain) of catching a train in short time, offered the driver of a rural four-wheeler double fare if he could make his specimen of the *genus equus* get to the station in time. They arrived just in time to see the receding tail-lights of the train leaving the station. The driver audibly used language of an order not tolerated in ecclesiastical circles. The chaplain asked the Bishop whether he should venture to reprimand the man. The answer was: "Nay; it is sometimes useful to have a substitute to give vent to one's feelings." The "wily canvasser" is a useful member of the staff of an electricity concern. Nevertheless, the author of the articles deprecates "wild and erratic statements with regard to the uses of gas which cannot be substantiated. Such methods are undignified, and not calculated to assist the cause of electricity. The comparative disadvantages of gas can be discussed in a sound businesslike manner which is worthy of the best traditions of the electricity industry, and at the same time will not give unwarranted offence to men of high commercial ability in the gas world, from whom we of the electricity supply industry have a lot to learn." The best-known traditions of the electricity industry in this particular connection are those associated with the "wild and erratic statements with regard to the uses of gas which cannot be substantiated." More is the pity that responsible men in the electricity industry have been parties to their publication and circulation. The author further advises that in advertisements remarks of an offensive nature should be avoided, as abuse cannot be regarded as sound argument. He also suggests the abandonment of the "great mistake" that has been made by electrical people of "persistently generalizing." A generous hope is that the advice will go home. There is plenty of room for improvement in the tactics of the electricity supply industry.

The "Estates Gazette" in "Notes by the Way" has been talking of the recent electrical outbreak of fire in the basement of the east wing of the British Museum, and has been endeavouring to compose any alarm that its readers may have felt as to the safety of the national priceless treasures by telling them of the practically fire-proof conditions of the museum structure. Electric lighting is now used in the main parts of the building, and gas is employed in the basements; and we know that there has been a fair amount of grumbling at the nature of the electric lighting by constant visitors to the place. However, our contemporary states that the reason electricity was introduced was that gas was unsafe, as well as destructive to books. Notwithstanding this assumed unsafety of gas, the buildings still stand; and the books are still in existence. The safety of electricity was demonstrated by the

recent fire, and the agility the attendants were called upon to display in getting the better of it before much damage was done. But the tenants of other buildings not constructed in the same fireproof style, and that are not so stringently guarded, in which electricity is used, will think of what might have happened to their own property if the same outbreak had occurred upon it. It is noted from the "Estates Gazette" that, notwithstanding the fireproof character of the structure, and the strict supervision of the attendants, "frequent visits" are paid by the senior officers of the brigade to see that every appliance is ready for immediate use in emergency. A staff of firemen patrols the building day and night, and with the police on duty, are able to take up definite fire-posts at any moment. There are numerous fire alarms inside; and hydrants and hand-pumps in every room. Bnt all electrically-lighted buildings are not British Museums.

There are a good number of Bills and Provisional Orders promised for next session in which electricity is concerned. But the greater number refer to traction; the smaller number, to general electricity supply. These again show a larger number of extensions of existing concerns than of promotions of fresh undertakings. A matter that is attracting attention is the number of gas companies who are applying for electric supply powers; and electrical people look upon this movement from opposite points of view. There are some who consider that competing undertakings are preferable—that competition means lower prices for the public, though possibly and very probably lower profit for the investors in the two enterprises. But there are other electrical people who look upon the matter in much the same way as the promoting gas company—as a matter of economic policy. There are many towns in the country which are not extensive enough to maintain two light, heat, and power concerns in a flourishing condition, and in which, through the economies producible under one energetic management, the community is more likely to be served at a cheaper rate than under a competitive system where prices must be of an order—if capital is to receive any return, and provision be made for depreciation—higher than would otherwise be the case. There are circumstances where competition does not spell economy. It is in these cases where the gas undertaking with land and fuel available for generating purposes, offices. administration, a distribution staff, meter readers, collectors, and so forth, can be converted into suppliers of the two agents with the utmost economy. There are some people who will have electricity; there are others who prefer gas. Many of these people take no notice of the considerations that are put forward *pro et con* by the respective dealers in these agents. The "Electrician" has been attracted by the fact that the gas companies of Crowborough, Ely Valley, Grays and Tilbury, Herne Bay, Porthcawl, Tottenham and Edmonton, Truro, and Westgate and Birchington are next session applying for electricity supply powers; and our contemporary takes an intelligent view of the applications when it says: "There is much to be said in favour of working electricity and gas together; and we believe that it has been found to give satisfactory financial results where it has been tried."

The Hove Town Council will, we fancy, find themselves in a "Fool's Paradise" before they have done with the purchase of the local electric supply undertaking. When the matter was last before the Council, it was found that various members had changed their coats, and were prepared to vote (though not doing so on a previous occasion) in favour of the transfer. The reason why is not clear, unless it is summed up in the statement of one speaker, that "he was not in favour of municipal trading," but he was one of those who were "determined to make the best of the concern in their midst." There are a lot of concerns in the midst of every community, but that is no justification for municipalizing them. The speaker referred to apparently thinks the system of municipal management is the way to make the best of the concerns in the midst of the Hove community. There are strong electrical experts who would tell the Council that nothing has been more injurious to the commercial progress of the electrical industry than the large extent to which it is municipally administered. In the discussion there was an instance not intended as an illustration of this, but as showing how the Corporation are prepared to act in relation to the local electrical contractors. There has been some fear that the Council might undersell the local contractors in electric wiring and appliances; but the pro-municipal electricity traders point in an unctuous manner to their self-sacrificing adoption of the clause (which, if they did not voluntarily adopt it, would be put upon them) that will compel them to work through the local contractors. Everything is apparently being done in Hove to prevent the ratepayers giving free expression to their views on the subject. The preliminaries on the Bill have been hustled through; and the ratepayers are being foolishly told by certain of the councillors how, if they oppose the Council in this matter, something terribly bad will happen. Something worse is likely to happen if they do not successfully oppose the Council. The Council are also nursing the view that they have done cleverly by going to Parliament instead of to the Local Government Board, and that Parliament is certain to give them a longer term for the repayment of the purchase loan for an electrical undertaking with plant encrusted by twenty years' depreciation. The Local Government Board will be interested to hear that their better knowledge of the life-periods of electrical plant, and consequently the better knowledge they possess than Parliamentary Select Committees as to what is a judicious term to allow for the repayment of purchase loans, is a reason in the municipal mind why the Board should be bye-passed in favour of Parliament in a matter of this kind. When the Hove Bill comes before Parliament, the Board might perhaps make a note of ths facts in their reports to the Committees, and state their view as to the proper repayment period on the purchase loan. The Corporation are hoping to get 40 years from Parliament. The ideas of Parliament in this matter are shrinking; for with the large proportion of long-life plant on gas-works, in the current session they refused three local authorities purchasing gas-works a repayment term of 40 years, and reduced it to 35 years. Hove must not pitch its expectations too high.

EXHIBITION OF THE PHYSICAL SOCIETY.

THE Physical Society of London last Tuesday held their eighth annual exhibition of electrical, optical, and other physical apparatus, at the Imperial College of Science and Technology, South Kensington. In addition to the various exhibits, there was a discourse both in the afternoon and in the evening, on "Some Methods of Magnifying Feeble Signalling Currents."

Not all the stands, of course, call for mention in these pages; but some of them may appropriately be briefly noticed. A quantity of their well-known apparatus was displayed (some of it in operation) by the Cambridge Scientific Instrument Company. This included the Féry bomb calorimeter, a double range indicator for temperature measurement, "H. & M." thermograph and index thermometers, and the Whipple temperature indicator. Various pyrometers (one of them the Foster fixed focus radiation pyrometer and graphic recorder) were exhibited by the Foster Instrument Company, as well as by Mr. Robert W. Paul. Messrs. A. Gallenkamp and Co.'s specialities included a sensitive flame low-pressure burner, for working on ordinary gas supply, designed by Professor S. P. Thompson, F.R.S., and a students' optical bench, with interchangeable fittings, for radiant heat experiments. Mr. J. H. Coste's still-water gas-calorimeter was to be found at the stand of Messrs. William Sugg and Co., and the "Metrogas" nitrogen test apparatus, at that of Messrs. Townson and Mercer. Messrs. Alex. Wright and Co. made an interesting show which included Simmance and Abady's patent gravitometer [see p. 959], which is suitable for gases of every specific gravity. It continuously records the specific gravity of a gas with an accuracy of 1 part in 1000. The same firm also displayed a new arrangement of the well-known Orsat gas analysis apparatus, and pointed out that it has great advantages of compactness, lightness, simplicity, and accuracy. Visitors were also enabled to see the excellent lighting effect given by Keith high-pressure gas-lamps, and some of the operations involved in the manufacture of "Volker" incandescent mantles.

Submerged Water-Pipes with Strong Joints.

During the construction of the Belmont Tunnel under the East River, New York, a few years ago, water pressure was delivered to the shaft on Man-of-War's Reef through a 4-inch wrought-iron pipe, submerged for a distance of about 1200 feet at a point where the tidal current is strong, the water deep, and the bottom irregular, with an abrupt depression in the middle. These features, together with the temporary character of the service required, made the contractors instal an unprotected 4-inch wrought-iron supply-pipe with joints strong enough to endure the stresses developed both in laying it and by its irregular support at unknown points a considerable distance apart. The following particulars of the work appeared in a recent number of "Engineering Record" (New York). The 20-feet lengths of pipe were assembled on the surface of the ground so as to make a length of 600 feet. The joints were made with M'Clusky malleable iron couplings. This joint consists of a sleeve with a hub at each end. The body between these hubs is provided with a right-hand standard thread screw from end to end. Four radial set-screws are provided in each hub, and their inner ends have a sharp cutting edge round the exterior surface. After the ends of the pipe are screwed into the sleeve, these set-screws are turned up as hard as possible; making their sharp edges cut into the surface of the pipe, and take positive symmetrical bearings there which, as soon as the pipe is put under transverse stress in any direction, take up the shear. This greatly relieves the stress on the threads, and increases the efficiency of the sleeve, which, being made of malleable iron, develops a higher ductility and tensile strength than ordinary cast iron. Lead was poured into the bells, filling the space around the set-screws, and was caulked, adding to the tightness of the joint; and the pipe was tested to a pressure of 80 lbs. by means of compressed air. Wooden shoes were wired to the pipe at alternate joints, thus supporting it on the ground; and two tugs attached at the river end pulled it forward and over the string-piece of the wharf, where it dropped 16 feet to the surface of the water without apparent injury to the pipe or the joints, though the former was kept at an angle of 45 degrees. The current was so strong that after about 500 feet of the pipe had been pulled forward and anchored by the portion still supported on shore, the swift tide swept one of the tug-boats down stream through a large arc, bending the pipe considerably. Both tugs together finally succeeded in pulling the pipe back into line and holding it there until the second section of 600 feet was joined to it; and both were finally pulled across the river into the required position.

HIGH-PRESSURE GAS AT MAIDSTONE.

AN EXAMPLE OF FACTORY LIGHTING BY HIGH-PRESSURE GAS.

THERE have been forwarded by Mr. Frank Livesey, the Engineer and General Manager of the Maidstone Gas Company, two photographs, one showing an arrangement of modern electric factory lighting, and the other an up-to-date installation of gas. The former represents the old factory of Messrs. Sharp and Co., manufacturing confectioners, of Maidstone, which is lit by metallic filament lamps; and the latter, the firm's new factory, lit with Keith high-pressure gas-lamps. Each photograph was taken after dark, and was given 1½ minutes' exposure. The one of the gas installation is given here, and shows clearly the efficient character of the illumination; but it would not be fair to print as a comparison the photograph of the electrically-lit factory, as it is so dark that a reproduction would amount to a study in black and white, with the white an almost imperceptible quantity. It may be mentioned that the new factory consists of two buildings; one being 180 feet long by 70 feet, and the other 120 feet long by 60 feet. The first of these is lit with twenty-three 300-candle power lamps, and the second with eighteen lamps of similar candle power.

Mr. Livesey states also that gas is to be extensively used for sugar boiling in the town. Nine boilers, designed and patented by Mr. L. F. Tooth, of the Commercial Gas Company, and manufactured by the Vulcan Stove Company, of Exeter, are to be installed. Gas is to be supplied to these boilers at a pressure of 54 inches; and 40 lbs. of material can be boiled in them in thirty minutes, with a consumption of from 75 to 85 cubic feet of gas. Several makes of sugar-boilers were experimented with; but the tests showed that this make of boiler was more economical than any other that was tried.

AMERICAN COMMERCIAL GAS ASSOCIATION.

Annual Meeting in Atlanta.

THE Eighth Annual Meeting of the above-named Association was opened in the Auditorium Armoury, Atlanta (Ga.), on the 3rd inst., under the presidency of Mr. C. L. Holman, of St. Louis. About 600 delegates were present. We learn from the special account of the proceedings telegraphed to the "American Gaslight Journal" that the Mayor was unable to attend to receive the Association, but he was represented by Mr. Aldine Chambers, who tendered the members the freedom of the city.

The business began with the presentation of the Directors' report, which showed that during the twelve months they had held four meetings (in Denver, Chicago, Detroit, and Atlantic City), that the membership totalled 2761, and that the Association had been incorporated under the laws of Missouri. The Secretary (Mr. Louis Stotz) submitted a report full of useful recommendations; and the Treasurer (Mr. W. H. Pettes) showed that the balance for the year had substantially increased. Next came the Inaugural Address of the President, in the course of which it was suggested that the Association and the American Gas Institute might possibly do better work if their forces were united than they can accomplish as separate organizations. Mr. O. H. Fogg, the Chairman of the Committee on Standardizing Gas Appliances, made some remarks to the effect that manufacturers, who had complained that the standards framed for adoption were too severe, should be afforded an opportunity of making their views known before the Committee presented their report; and this was agreed to. Then came the election of office-bearers for the ensuing year. The list being as follows:

President.—Mr. C. W. Hare, Philadelphia (Pa.).
First Vice-President.—Mr. C. M. Cohn, Baltimore (Md.).
Second Vice-President.—Mr. G. D. Roper, Rockford (Ill.).
Treasurer.—Mr. W. H. Pettes, Newark (N.J.).
Secretary.—Mr. Louis Stotz (New York).
Directors.—Messrs. A. P. Brill (to fill unexpired term of Mr. C. W. Hare), O. H. Fogg, J. A. Norcross, H. N. M'Connell, F. P. Lane, and G. R. Chamberlain.

Philadelphia was chosen as the next place of meeting; and Minneapolis (through its Mayor) sought to have the convention held there in 1914. The Pacific Coast Gas Association made a strong appeal to have the meeting in San Francisco in 1915, to participate in the Gas Congress in commemoration of the work accomplished in the construction of the Panama Canal. The American Gas Institute had sanctioned a similar proposal at the meeting in Atlantic City in October. A Committee was appointed to consider the invitation and proposal; and the debate was notable for an excellent speech in support of the idea by Mr. Walter R. Addicks, the President of the Institute.

In the afternoon, the first paper was considered. The subject was "Gratuitous Work for Consumers: The Reasons, Precautions, and Remedies;" and its author (Mr. E. C. Weisgerber, of Cedar Rapids) was well rewarded for his clever presentation of a decidedly perplexing subject by a discussion that brought out diverse views in respect of policy. The second paper was by Mr. R. F. Pierce, of the Welsbach Company, Gloucester (N.J.), whose handling of the subject of "The Sale of Gas for Illumination," also gave rise to a lively debate.

There was no morning sitting either next day or on Thursday, to allow members to visit the gas exhibition which was being held in connection with the meeting. In the afternoon, the first matter to occupy attention was the appointing of a permanent Committee on Public Policy; Mr. C. N. Stannard being nominated as the Chairman. Next came the report of the Committee on the President's Address; and concurrence was expressed with practically all his suggestions, even the one in respect of taking some steps in the direction of bringing the Association and the Institute closer together. The only paper considered was one by Mr. A. F. Krippner, on "Artificial Gas for House Heating, and its Possibilities." The paper, which was a long one, was illustrated by lantern views.

On Thursday afternoon, the first paper was on "Efficiency in the Advertising Department," by Mr. E. S. St. Elmo Lewis, the representative of a concern doing a large business with gas companies in the sale of adding-machines. Then came a paper by Mr. John S. Welch, of Philadelphia, on "Industrial Fuel as a Revenue Producer, and Methods for the Development of Large Consumers," dealing with matters on which the author is thoroughly well informed. This left on the list only two subjects —a paper on "Sales Campaigns," by Mr. James P. Hanlan, of Newark (N.J.); and a lecture on "The Education of Employees," by Dr. Lee Galloway, of New York.

CALORIFIC CONTROL OF GAS-MAKING: ITS USE AND LIMITATIONS.

By Jacques Abady.

For a good many years the calorific power of gas has been recognized as being a matter of importance to those who are engaged in the manufacture of gas; and although the practice of making calorific tests is fairly general, it can by no means be considered universal.

Whether or not it is wise, from the consumer's point of view, and whether or not it is expedient, from the gas maker's point of view, signs are not wanting (as evidenced by arrangements between municipalities and gas-works on the Continent, by Acts of Parliament in England, and by State Ordinances in America) that there is a tendency to set up, in place of candle power, a standard of calorific power. It is the purpose of this article to discuss this situation in all its bearings, and to carefully analyze its influence upon gas-works' practice generally; and I think that such discussion opens up a great many matters which at first sight would not appear to be connected with it.

It has been stated for a good many years past that "the calorimeter is the future photometer." But I do not think that those who have made this prophecy had it in their minds that, because a calorimeter would displace a photometer, therefore no other test of any kind was, or would be, necessary or of value. It would be just as reasonable to assume that under a photometric standard one could lose sight of all other aspects, and abandon oneself entirely to a photometric standard. It does not need me to say that this is far from being the case; but it seems to me that it requires somebody at the present juncture to consider carefully whether all other standards or guides could be abandoned save and except the sole one of calorific power.

It must be realized, and I think it has been realized, by all who have considered the matter, that it is one thing to make tests of calorific power from curiosity or for general informative purposes, but quite another thing to set out to make gas of a certain heating value and maintain it constantly at such value.

It is a certain thing that, if the old standards of illuminating power and sperm value per ton are to be abandoned, it becomes a matter of the most urgent importance to gas makers to consider seriously, from every point of view, the value as an accurate guide of any new standard which is set up in the place of the deposed candle power one.

I think that I ought to make clear what I mean by an accurate guide. I mean a guide which governs a great many things. A guide, to be universal, should be capable of governing the choice of a carbonizing system; it should be capable of governing the selection and purchase of coal; and it should be capable of governing the method of conducting carbonization. If a bare statement of calorific power (whether net or gross) does not furnish the above guide, then it will be seen that in fixing upon, or in acquiescing in the adoption of, calorific power as a sole standard, gas makers will be making a grave error.

I propose, therefore, to endeavour to make clear the bearing which calorific power appears to me to have upon the actual quality or value of gas. The suggestion I advance (and it has been advanced before) is that a mere statement of "gross" or "net" calorific power does not convey to the gas maker, and certainly does not convey to the gas consumer, the complete value of such gas. This has been recognized for a long time; so much so, that M. André Grebel made his suggestion on "Comburimetry" at the summer meeting of the Société Technique du Gaz en France; the basis of this being the ascertainment of the amount of air required for the combustion of gas, and the general effect of the combustion of a certain quantity.

It really comes to this—that it is one thing to produce a gas of a certain calorific power by means of making a rich gas and over-pulling (thus reducing the calorific power to the desired figure by the admixture of carbon dioxide and nitrogen), and it is a very different thing to produce a gas of a required calorific power by increasing the methane and carbon monoxide and keeping the nitrogen and carbon dioxide to a minimum. The reason, of course, is that a gas which contains a large percentage of inert constituents affects the flame temperature; and I think it is quite a conservative thing to say that inert constituents, particularly nitrogen, affect the flame temperature to a greater degree than they do either the illuminating power, as measured in a No. 2 "Metropolitan" burner, or the calorific power, as measured in a calorimeter.

In this connection, I would bring to mind Dr. Davidson's figures of the experiments he made with gas of a certain thermal value and candle power, in which he determined the influence on both the heating and the candle power which the increase of 1 per cent. of each constituent would have. To save reference, I set out Dr. Davidson's figures as Table I. It must be remembered that calorific power and flame temperature are totally different things.

To be quite frank, the question of admixture of nitrogen and carbon dioxide with a low calorific standard is closely bound up with the question of large makes; and it may be that those who are not circumstanced so as to be able to use coal of a suitable quality, or to manipulate their carbonization in such a way as to produce a large make, will stoutly deny the truth of the suggestion I am emphasizing with reference to nitrogen and carbon dioxide. I want to make it clear, therefore, that I am not purporting or endeavouring to deal with this matter from a mere commercial point of view, but am trying to emphasize certain facts which appear to me to be capable of scientific proof.

Table I.—*Dr. Davidson's Figures of Effect of Increase of 1 per cent. of the Various Constituents of a Gas of 540 B.Th.U. (4806 Calories per Cubic Metre) and 16 Candle Power upon the Calorific and Illuminating Power of Such Gas.*

—	Calorific Power.	Illuminating Power.	Ratio.
	Per Cent.	Per Cent.	
CO_2	− 1·0	− 3·5	1 to 3·5 decrease
O_2	− 1·0	− 3·0	1 to 3·0 ,,
N_2	− 1·0	− 2·6	1 to 2·6 ,,
Air	− 1·0	− 2·7	1 to 2·7 ,,
CO	− 0·4	− 0·9	1 to 2·3 ,,
H_2	− 0·5	− 0·5	1 to 1·0 ,,
CH_4	+ 0·8	− 0·4	cal. inc. = twice I.P. dec.
C_2H_4	+ 1·8	+10·9	1 to 6 increase
C_6H_6	+ 6·0	+18·0	1 to 3 ,,
$C_{10}H_8$	+10·5	+125·0	1 to 12 ,,

If, therefore, it is conceded that what I say as to different compositions of gas of the same calorific power is correct, then it must, indeed, be conceded that calorific power alone, while it may be convenient as a bargain between the consumer and the gas maker, is not ultimate, and is not satisfactory as a guide to the man who is making gas and who is anxious to do the best he can with every ton of coal he is carbonizing. It must further be conceded that a calorific standard, *per se*, is certainly no guide to the man who is torn (as many gas makers are) with conflicting doubts as to the relative merits of horizontals, inclined retorts, intermittent and continuous vertical retorts, steaming, chamber ovens, admixture with carburetted water gas, admixture with blue water gas, and benzol or other enrichment. There is further the debatable question of heavy charges and light charges; and above all the problem of proper regulation of heat in carbonization.

In these circumstances, I have felt it to be a practical thing to endeavour to find what tests supplementary to that of calorific power are desirable or necessary. In order to do this, I have carefully examined a great many figures of published results obtained by different methods of carbonization; and in Table II., I give the items in the published data which appear to me to bear upon this investigation.

The chief of such items are the quantity of gas, its candle power, its calorific power, the percentage of its various constituents, and its specific gravity. If the figures are carefully examined, a good many of what I might term natural inconsistencies will be apparent; and they appear to point to the fact that gas analysis is not conducted on sufficiently exact lines. With respect to the specific gravity of the various gases, in a great many cases these were not published. I have, therefore, calculated them from the data given in Table III.; and as the calculated figure in many cases disagrees with the stated figure, this affords additional confirmation as to what I say about the inaccurate way in which gas analysis is conducted. I do not suggest that these tests have not been carefully made; but I do suggest that in many cases methods have been employed which are not capable of giving reliable data. However, I refer later more particularly to this point.

Now if Table II. is carefully examined, it will be seen that an increase in calorific power is generally, though not always, accompanied by a decrease in specific gravity. It will further be seen that it may be taken for granted that if the specific gravity shows any material increase, this, in nine cases out of ten, shows the presence of carbon dioxide or nitrogen.

It therefore seems to me to be quite a sound procedure to arrange for the continuous record or indication of specific gravity and to be on the watch for increases, and, when these increases occur, to get at the bottom of their meaning by the simple expedient of bye-passing the gas through an experimental lime purifier before its gravity is observed. It will follow that if, after this extraction of the carbon dioxide, the gravity is still high, then undoubtedly it must be due to the presence of a high percentage of nitrogen.

We have advanced thus far, therefore, that the addition to the calorific power test of a specific gravity check furnishes a simple guide to the percentage of carbon dioxide and nitrogen.

I make no pretence to a large practical experience of carbonization; but so far as my reason points it appears to me that, if one can be certain of keeping down the percentage of carbon dioxide and nitrogen, then an increase in the calorific power should be accompanied by an increase in gravity, for the reasons which I set out below.

This fact furnishes an additional argument for the use of a specific gravity test, though it follows that for the latter purpose, and if any complete information is required as to what is being done in the retort-house, it is absolutely necessary to take frequent analyses of the gas. This does not appear to be a strikingly original statement; but I think that the importance which the percentage of methane, carbon monoxide, hydrogen, and nitrogen have is not sufficiently appreciated. For this reason, I suggest that they should be estimated with absolute certainty; that it is utterly useless to take nitrogen by difference; and, further, that it

TABLE II.—*Analyses of Gases.*

Type of Retort.	Source.	Coal Used.	Make in Cub. Ft. per Ton.	Make in Cub. Met. per 1000 Kilos.	Ill. Power No. 2 "Met." Burner.	Calorific Power. B.Th.U. per Cubic Foot.		Calorific Power. Calories per Cubic Metre.		Calculated Sp. Gr. Air = 1.	Analysis.						
						Gross.	Net.	Gross.	Net.		CO_2.	O_2.	C_nH_m.	CO.	CH_4.	H_2.	N_2.
Dessau vertical	East Hull	..	13,953	388	14·90	542·0	490·0	4864	4361	·419	1·9	0·4	3·3	9·9	28·96	50·18	5·36
,, ,,	Sunderland	..	12,647	351·5	..	..	520·0	..	4618	·414	1·35	0·4	3·63	7·63	30 46	49·9	6·63
,, (steaming)	Derby test	..	13,381	372	15·47	591·2	528·8	5262	4706	·405	2·2	0·4	3·4	7·8	29·8	51·6	4·8
,, (not steaming)	,,	..	12,480	347	15·63	597·6	534·8	5318·5	4760	·422	2·4	0·3	3·9	8·0	31·2	49·3	4·9
Glover-West vertical	H. G. Colman	Orrell nuts	11,448	318	16·86	594·0	542·9	5286·5	4832	·406	2·1	..	2·7	9·9	32·4	49·7	3·0
,, ,,	,,	,,	,,	,,	16·06	580·4	525·8	5165·5	4679·5	·400	1·8	..	2·8	10·0	31·2	51·3	3·1
,, ,,	,,	,,	,,	,,	16·19	589·4	527·2	5265·5	4692	·396	2·0	..	2·6	9·8	32·3	51·0	2·1
,, ,,	,,	Durham	13,102	364	15·56	573·6	514·5	5106	4579	·367	1·0	0 05	2·85	8·7	29·05	54·7	3·2
,, ,,	,,	Silkstone	12,435	345·5	16·19	584·9	522·0	5205·5	4646	·364	1·1	0·2	2·7	7·3	32·3	53·75	2·4
,, ,,	,,	Wigan	12,145	337	15·22	576·2	516·0	5132	4592·5	·378	1·15	0·15	2·45	7·3	33·9	51·65	3·25
Woodall-Duckham vertical	,,	Lambton (Durham)	12,968	360·5	..	560·7	499·3	4990	4444	·397	1·6	0·2	3·0	9·6	26·0	55·8	3·8
Glover-West vertical	Glover	Wigan	14,357	399	14·50	541·0	496·0	4815	4404·5	·380	1·7	..	3·0	10·3	27·23	55·1	2·69
Dessau vertical	Dr. Davidson	..	12,000	333	15 00	..	500·0	..	4450	·420	2·4	0·5	2·8	10·3	28·0	51·0	5·0
Glover-West vertical	Manchester	Lancashire	11,868	330	17·23	586·0	524·0	5215·5	4663·5	·400	2·10	..	3·2	9·1	31·49	51·18	2·83
,, ,,	,,	,,	13,033	362	15·43	551·0	494·0	4904	4396·5	·412	2·53	0·27	2·34	10·7	26·94	52·27	2·86
,, ,,	,,	Yorkshire	12,059	335	17·01	578·0	516·0	5144	4592·5	·340	0·9	..	3·6	6·2	30·4	57·11	1·29
,, ,,	,,	,,	14,236	395·5	15·35	548·0	491·0	4877	4370	·363	1·0	0·3	3·1	6·7	28·44	56·06	4·4
,, ,,	,,	Derby	11,584	322	17·12	582·0	544·0	5180	4841·5	·390	1·8	..	3·45	9·3	31·54	52·06	1·85
,, ,,	,,	,,	14,258	396	15·38	522·0	489·0	4646	4352	·417	2·0	0·3	3·1	10·2	27·54	51·30	5·56
Horizontal (level gauge)	Dr. Davidson	..	12,000	333	18·00	..	525·0	..	4672·5	·440	2·2	0·5	3·4	9·7	31·5	47·3	5·4
,, (over-pulling)	,,	..	12,800	356	15·00	..	500·0	..	4450	·480	2·7	0·7	3·3	9 8	27·3	44·6	11·6
,,	Gas Institution Carbonization Committee	Derby	12,091	336	15·56	608·20	554·6	5413	4936	·421	2·2	0·3	3·8	5·6	32·9	48·6	6·6
,,	,,	,,	11,820	328·5	16 29	586·80	530 4	5222·5	4720·5	·464	2·6	0·3	3·3	5·2	34·0	43·5	11·10
Koppers horizontal chambers	Vienna	Ostrau-Karwen	11,590	321	..	612·0	..	5447	..	·409	3·0	0·4	3·0	9·2	28·0	52·4	4·0
,, ,, ,,	,,	,,	11,774	327	..	618·0	..	5500	..	·401	2·6	0·2	3·0	9·4	29·2	52·4	3·2
,, ,, ,,	,,	,,	12,199	339	..	623·0	..	5545	..	·392	2·2	0·6	2·6	9·2	28·7	53·6	3·1
,, ,, ,,	,,	,,	12,051	335	..	606·0	..	5393·5	..	·395	2·6	0·4	3·0	9·0	28·0	53·6	3·4
,, ,, ,,	,,	,,	11,500	320	..	610·0	..	5429	..	·393	2·6	0·4	2·8	9·4	27·6	54·0	3·2
Coal gas	J. G. Taplay	..	..	..	15·70	591·0	525·5	5260	4677	·443	1·67	1·49	3·34	6·23	35·30	44·43	7·46
,, ,,	,,	..	..	..	..	561·0	498·0	4993	4432	·454	2·28	1·57	C_6H_6 0·09 3·08	6·92	30·70	45·55	9·89
Carburetted water gas	,,	..	..	..	18·80	557·0	510·5	4557	4543·5	·656	3·11	0·89	8·37	31·52	15·69	32·61	7·80
,, ,, ,,	,,	..	..	..	..	542·5	497·0	4828	4423	·664	2·55	0·79	6·58	34·07	17·99	29·43	8·59
Mixed coal and carb. water gas	,,	..	..	..	..	528·5	472·5	4703·5	4205	·496	2·55	1·23	3·87	13·03	25·39	44·08	9·84
,, ,, ,, ,, ,,	,,	..	..	..	..	592·5	530·5	5273	4721·5	·482	2·09	0 82	4·71	12·06	29·00	44·47	6·58
,, ,, ,, ,, ,,	,,	..	..	..	14·00	543·0	484·0	4833	4307·5	·485	2·30	0·71	C_6H_6 0·27 3·99	9·30	27·77	44·19	11·74

TABLE III.—*Certain Properties of Various Gases.*

—	Molecular Formula.	Vols. Air.	Vols. Oxygen.	Vols. of Products.		B.Th.U. per Cubic Foot.		Calories per Cubic Metre		Ratio of Net to Gross.	Specific Gravity Air = 1.	Weight of a Cubic Metre in Grams at 0° C. and 760 mm.
				CO_2.	H_2O.	Gross.	Net.	Gross.	Net.			
										Per Cent.		
Oxygen	O_2	..	..	..	..	..	..	..	..	..	1·105	1429·6
Nitrogen	N_2	..	..	..	..	..	..	..	..	..	0·968	1252·1
Carbon dioxide	CO_2	..	..	..	..	..	..	..	..	..	1·529	1965·2
Hydrogen	H_2	2·38	0·5	..	1·0	329·5	276·0	2932·5	2456·5	83·7	0·069	89·9
Carbon monoxide	CO	2·38	0·5	1·0	..	325	325·0	2892·5	2892·5	100·0	0·967	1250·6
Methane (Paraffins C_nH_{2n+2})	CH_4	9·52	2·0	1·0	2·0	1018	911·5	9060·2	8112·5	89·5	0·562	715·06
Ethane (Paraffins C_nH_{2n+2})	C_2H_6	16·66	3·5	2·0	3·0	1773	1613·5	15,780	14,360	91·0	1·033	1241·3
Propane (Paraffins C_nH_{2n+2})	C_3H_8	23·8	5·0	3·0	4·0	2519	2307·5	22,419	20,537	91·6	1·514	1967·3
Ethylene (Olefines C_nH_{2n})	C_2H_4	14·28	3·0	2·0	2·0	1624	1517·5	14,453	13,506	93·4	0·982	1251·03
Propylene (Olefines C_nH_{2n})	C_3H_6	21·42	4·5	3 0	3·0	2378	2218·5	21,164	19,745	93·2	1·445	2095·5
Butylene (Olefines C_nH_{2n})	C_4H_8	28·56	6·0	4·0	4·0	3132	2919·5	27,875	25,984	93·2	1·930	2503·4
Acetylene	C_2H_2	11·9	2·5	2·0	1·0	1505	1452·0	13,394	12,923	96·4	1·898	1162·1
Benzene	C_6H_6	35·7	7·5	6·0	3·0	3708	3548·0	33,001	31,577	95 6	2·691	3486·3

is important that the carbon density of the unsaturated hydrocarbons should also be determined.

I said a moment ago that given a low percentage of nitrogen and carbon dioxide, then an increase in calorific power should be accompanied by an increase in gravity. I base this view upon two facts.

The first is that if one takes any typical analysis, one will be struck by the fact that from 45 to almost 60 per cent. of gas consists of hydrogen, which has the lowest calorific power of any of the constituents of coal gas, and is exceedingly light. I further believe what the carbonization experts tell us—viz., that the ideal to aim at is the combination of some of this hydrogen with carbon, so as to increase the formation of methane, and, secondly, reduce the percentage of hydrogen. Seeing that the calorific power of methane is three times that of hydrogen, and its specific gravity is eight times that of hydrogen, it follows that any improvement in this direction means an increase in calorific power, accompanied by an increase in gravity.

The second reason is that though it is customary to consider

the olefines as ethylene (C_2H_4), yet a determination of the carbon density of these olefines will in many cases reveal the fact that they consist not only of ethylene, but propylene and hydrocarbons of a higher value, and also that the carbon density of these olefines varies in different gases. Now, seeing that the higher the carbon index the greater the calorific power (the calorific power of propylene, C_3H_6, for instance, is 50 per cent. more than ethylene, C_2H_4), and that the gravity is also proportionately greater, it follows that any increase in the carbon density which increases the calorific power, will also be accompanied by an increase in the specific gravity. It, therefore, follows that if my assumption as to the desirability of increasing the methane and increasing the carbon density of the hydrocarbons is correct, then my statement that an increase in calorific power should be accompanied by an increase in gravity is also correct.

In this connection, I refer to Table IV. This table gives some figures of carbonization tests, in which the heat of carbonization was all that was varied. It shows that, as the heats are driven up, the specific gravity of the gas becomes lighter, because, no doubt, the hydrocarbons have commenced to split up, and there is, consequently, a formation of hydrogen. As the heats are lowered, the calorific power increases, and the specific gravity of the gas increases as well.

TABLE IV.—*Showing Diminution of Calorific Power and Gravity with Increasing Heat of Carbonization.*

Coal.	Make.		Calorific Power.				Specific Gravity free from CO_2.	Percentage Ratio of "Gross" to "Net" Calorific Power.
	Cub. Ft. Per Ton.	Cub. Met. per 1000 Kilos.	B.Th.U. per Cubic Foot.		Calories per Cubic Metre.			
			Gross.	Net.	Gross.	Net.		
No. 1	14,630	406·714	521·6	460·4	4642·24	4097·56	·367	88·2
,,	14,250	396·15	532·0	470·8	4734·80	4190·12	·371	88·4
,,	12,255	340·689	595·2	533·6	5297·28	4749·04	·403	89·6
,,	12,160	338·948	626·0	558·4	5571·40	4969·76	·413	89·2
,,	11,970	332·752	629·6	564·4	5603·44	5023·16	·423	89·5
No. 2	11,780	327·484	566·4	502·8	5040·96	4474·92	·402	88·7
,,	11,590	322·202	578·0	516·0	5144·20	4592 40	·423	89·2
No. 3	11,210	325·538	563·2	500·0	5012·48	4450·00	·423	88·7
,,	11,020	306·356	560·4	494·4	4987·56	4400·16	·383	88·3

Apart from the question of specific gravity, there is a point in connection with hydrogen which should not be lost sight of, and, indeed, it is hardly necessary for me to refer to it. It is, that information can be gathered as to the relative percentage of hydrogen by a comparison of the percentage ratio of the "net" to the "gross" calorific power of a gas, because the greatest difference is, of course, found when the percentage of hydrogen is the highest, as is shown by the ratios of "net" and "gross" which are set out in Table III.

A study of the percentage ratio of "gross" to "net" heat values in Table IV. confirms the explanation I advance, because, as the gas gets poorer in quality and lighter in weight, the ratio of "net" to "gross" decreases—showing that it is an increase in the percentage of hydrogen which accounts for the falling off in calorific power and in gravity.

It may be convenient at this point to sum up what I have endeavoured to convey.

1.—That calorific power, while being a convenient expression, does not by itself convey the true comparative value of gas.

2.—That the "net" and "gross" should be both ascertained, so as to furnish a guide as to the percentage of hydrogen.

3.—That the specific gravity should be continuously indicated or recorded side by side with tests on calorific power, so as to indicate the presence of carbon dioxide and nitrogen.

4.—That it is of the utmost importance to ascertain by a direct test the percentage of methane, carbon monoxide, hydrogen, and nitrogen.

5.—That it is of the utmost importance to determine the carbon density of the unsaturated hydrocarbons.

6.—That in working with a specific gravity recorder or indicator side by side with a calorific power recorder, four things may happen:

(*a*) Calorific power may increase as well as gravity. This, in the absence of carbon dioxide, indicates ideal working.

(*b*) Calorific power may increase but gravity decrease. This indicates that the gas of lower calorific power was lower because there was more nitrogen in it; and the increase in calorific power under these conditions would indicate that the excess of nitrogen has become less.

(*c*) Calorific power may decrease and gravity decrease too. This would appear to indicate excess heats whereby the hydrocarbons have been split up, forming hydrogen, and thus reducing the calorific power and producing a lighter gas.

(*d*) Calorific power may decrease and gravity increase. This indicates the presence of carbon dioxide and nitrogen in excess.

I am assuming in making the above suggestions that the percentage of carbon dioxide is carefully watched, which it can be, by recording the gravity with and without the carbon dioxide removed.

Construction of Flow Calorimeters.

I now propose to deal with the second part of my subject, which is an explanation and description of what appear to me to be satisfactory means of making the above observations, together with an examination of the true principles underlying calorimeter construction and the relative value of "gross" and "net" results, in view of the recent discussions which have taken place on this subject, particularly in America.

A calorimeter should embody several desiderata. It should be capable of easy manipulation or of doing work in a commercial way, and yet give accurate results. It should be capable of absorbing all the heat of combustion of the gas used in making a determination; it should be free from outside influences, the principal of which I should call the influence of varying currents of air during a test, the influence of varying flow of water during a test, and the influence of losses by radiation. Further, it should be free from error due to alteration of the rate of burning the gas, within reasonable limits.

A calorimeter, if properly designed, should embody all these points; and, while I do not say for a moment that there are not many calorimeters which are properly designed, it will suffice if I just emphasize these points, and make it clear that the Simmance-Abady calorimeter embodies these essentials.

It might appear a matter of supererogation on my part to point out, or even refer to, these details; but I do not think the effect of these varying influences is even considered, and is therefore quite unappreciated. When I state that it has been shown a possible normal occurrence to return (in perfect *bona fides*) the calorific power of gas 40 to 50 B.Th.U. too low, from one or other of these causes, it will be seen that an ordinary calorimeter is almost as undesirable an instrument from the gasmaker's point of view as was the No. 1 argand burner.

Total Heat and "Gross Heat" Compared.

Now Dr. Rosa has raised a point (which has, indeed, been discussed before), that the "gross" heating value may vary, not by reason of a variation of the actual gross heating value of the gas, but by reason of a variation in the temperature and hygrometric condition of the air entering the calorimeter and of the products leaving it; and he goes on to argue (what has indeed been argued many times before) that for this reason it may possibly be expedient to return the calorific power of any gas in "net" values instead of in "gross."

Dr. Rosa has put it that the "total" heating value is a correct value, and can only be measured by a flow calorimeter if the air admitted to the calorimeter at room temperature is dry and if the total products of combustion are cooled to room temperature, and that all the water vapour is condensed to water; or under such conditions that the water of combustion (and no more) is condensed, and that the products take away just the same amount of vapour as was passed through the calorimeter.

Now if this statement is carefully examined, it will be found to be perfectly true from a point of view of scientific accuracy; and if, further, an attempt is made to compare the possible difference, under ordinary circumstances of testing, between "total" heating value (as thus defined) and "gross" heating value (as generally

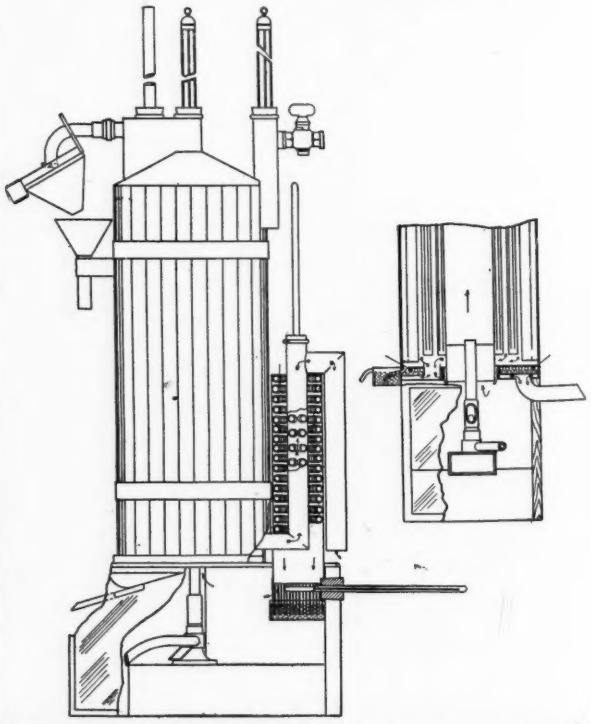


Fig. 1.—Simmance-Abady "Total Heat" Calorimeter. [Two Forms.]

known), it will be seen that practically always the "gross" heating value will be less than the "total" heating value.

These facts, as pointed out by Dr. Rosa, are, I confess, not new to me; and I do not suppose they are new to anyone who has studied the subject of calorimetry. But I must further confess that I have never considered that the difference between "total" and "gross" was of sufficient importance to warrant the production of a flow calorimeter which would render the ascertainment of total heat value quite an easy matter. The Committee of the American Gas Institute, however, which reported on "Thermal Value" and presented its report to the meeting of the Institute held at Atlantic City in October, 1912, evidently considers that it is of importance that such a calorimeter should be available; and, as it is possible what America thinks to-day the world may think to-morrow, I draw attention to a modified form of the Simmance-Abady calorimeter, in which the total heat value is ascertained, instead of the gross value.

It will be seen that this change is performed by a very simple addition—viz., by ensuring that all the air entering the calorimeter enters it at the same temperature as the issuing products of combustion, and, moreover, enters it in the same condition of saturation as obtain in the issuing products. This interchange, or securing what may be termed a "thermal-humidity balance," we have accomplished in several ways, two of which are shown in fig. 1. It will be seen that the incoming air is warmed by the outgoing products or *vice versâ;* and, being artificially saturated at the temperature of entry, the air always enters the calorimeter in a state of practical saturation, and, of course, the products always leave the calorimeter saturated.

It must be understood that, in order to get the closest agreement with accuracy, the temperature of the cold water should also be regulated by the thermal balance; and this we have also arranged by a device not shown in fig. 1. It may be stated, however, that, as applied to the determination of average gas, the results by this "thermal-humidity balance" are always within one-quarter per cent. of theoretical accuracy (on the high side); while without this "thermal-humidity balance," the calorific power of a gas may be shown by any calorimeter as much as 10 or 12 B.Th.U., or nearly 2 per cent., too low. Apart from this advantage, this "thermal-humidity balance" arrangement renders the calorific test free from the influence of inexpert or biased manipulation, which, as I have already stated, may operate against the gas to an extent of 40 or 50 B.Th.U.

"Net" or "Gross"?

To deal further with the question as to the relative advisability of returning "net" calorific power instead of "gross" or "total" is somewhat outside the scope of my present purpose; but I do not see, nor have I ever been able to see, any soundness in the argument that because a consumer, under some circumstances, only obtains the equivalent of the "net" heating value, therefore the "net" heating value should be the one credited to the gas. It seems to me that this argument is just as absurd as to say that gas will only give 5 candles per cubic foot in a mantle, because a consumer might burn the gas in a bunsen burner with a broken or defective mantle which would only yield a light of 5 candles per cubic foot.

To the scientific mind, it certainly would appear that since the design of a calorimeter which will give the absolute or "total" heating value has been accomplished, this is the value which should be taken as representing the heating value of gas.

As I have pointed out above, however, the "net" value, by reason of the indication which its comparison with the "gross" gives of the hydrogen in the gas, is not a factor to be neglected; and it can readily be obtained by means of a flow or recording calorimeter suitably calibrated.

Recording Calorific Power.

In the Simmance-Abady calorgraph the means by which we attain what is necessary—*i.e.*, the flow of gas, unsaturated by water vapour at a constant rate whatever its gravity may be—are probably well known to a great many; but for the information of those who are not familiar, I append a description dealing with the basic points in its construction.

The recording calorimeter may be looked upon as a combination of a specific gravity indicator and a sensitive differential recording thermometer. The gravity portion, however, is utilized, not as an indicator, but as a means of automatically loading a pressure governor. The gas on entering the apparatus passes first a sensitive regulator, whence it enters a chamber, the exit of which is controlled by a valve. This valve is suspended by a balance, and it is this balance which is acted upon directly by the actual weight of gas, as, after passing the governor mentioned above, the gas is branched in a separate stream over the specific gravity bell, and is burnt above it as a separate jet. Thus, if a heavier gas is fed to the calorimeter, the effect of its weight is also felt in the specific gravity balance, which, being loaded additionally by the extra weight of gas, affords an extra pressure to the original main flow of gas passing to the burner, which is the source of heat in the calorimeter. That there is ample power in the gas density alone to regulate an auxiliary gas supply, will be appreciated when it is mentioned that the passing of London gas through the specific gravity regulator relieves the valve balance of over 50 grains of weight. By these means a constant supply of gas to the burner is maintained, irrespective of any changes in specific gravity.

The differential thermometer is composed of opposing diaphragms actuating a four-bar mechanism, carrying a pen and inscribing on a chart. The diaphragms are lined throughout with a plating of palladium, are hermetically sealed, and contain air under pressure. The use of palladium in preserving the surfaces of metals where oxidation or corrosion would directly interfere with the working of the apparatus has enabled us to dispense with a meter or other measuring apparatus, so that the instrument, when set up, will deliver gas to the burner at a constant and invariable rate, whatever fluctuations may take place in the gravity of the gas the calorific power of which is being recorded.

Recording Specific Gravity.

From the above description it will be seen that a new form of

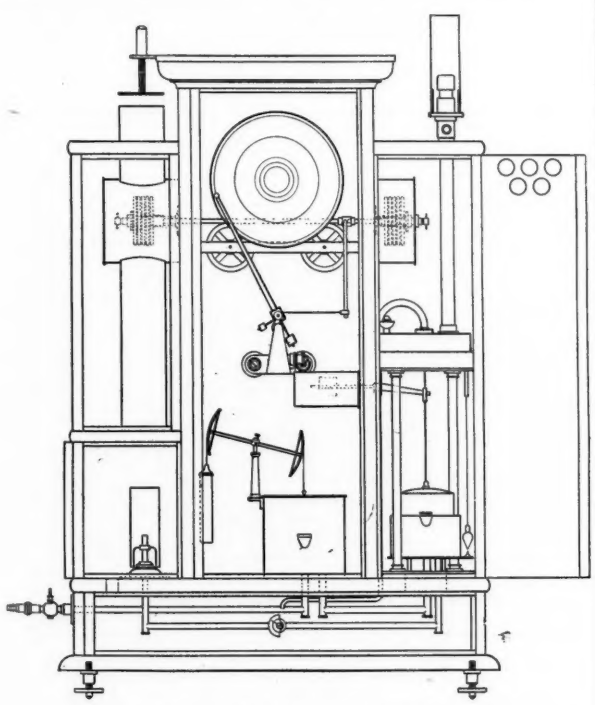


Fig. 2.—Diagram of the Simmance-Abady Calorgraph.

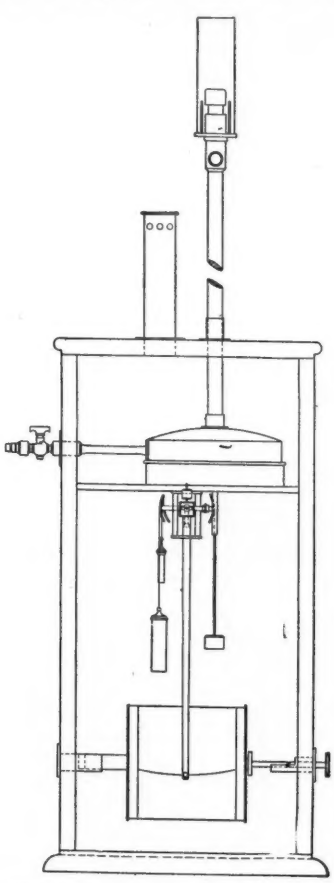


Fig. 3.—Diagram of the Simmance-Abady Gravitometer.

apparatus, influenced by changes of gravity and independent of changes in atmospheric condition, has been utilized by us; and I might make it clear that this new form of apparatus is also utilized by us to solve the difficulty (which has hitherto only been partially solved by Lux) of continuously indicating the specific gravity of gas. The power at our disposal in this apparatus is, fortunately, so great that not only are we able to make it indicate, but we can also make it record on a chart; so that we consider, rightly or wrongly, that its invention is a matter of some importance to the gas industry, and marks a distinct step forward.

The instrument by which specific gravity is automatically recorded is called the "Gravitometer," and is shown in diagrammatic form in fig. 3.

Some Points in Gas Analysis.

In dealing with the final points which I wish to emphasize—viz., the exact determination of hydrogen, methane, and nitrogen, and also the carbon density of the hydrocarbons (both of which I have referred to above)—a long experience of gas analysis leads me to believe that the whole essence of the analysis of residual gas lies in avoiding mixtures of air or oxygen and the uncertainties attendant upon the explosion. These uncertainties and the consequent inaccuracies in analysis are due to the fact that, in order to get perfect combustion of such residual gas, and in order to avoid the formation of nitric acid or aldehydes or free hydrogen and carbon dioxide, it is obvious that one must draw into the apparatus the exact amount of air and effect the combustion at the proper pressure.

Now one cannot know what the proper conditions are in these respects unless you know the percentage of combustibles which the residual gas contains; and it is this very percentage which it is the object of gas analysis to ascertain. It follows that the use of the explosion method is a species of walking backwards; and I believe that it frequently leads to the conscientious return by a chemist, of figures for hydrogen, methane, and nitrogen which are fallacious and misleading. As to the nitrogen, of course, the fact that nitrogen is taken by difference—thus being a sum of the errors in the whole analysis—is surely a counsel of despair. I therefore consider that as a correct knowledge of the percentage of these constituents is so essential, it is of the utmost importance that they should be ascertained by a method which is absolutely reliable.

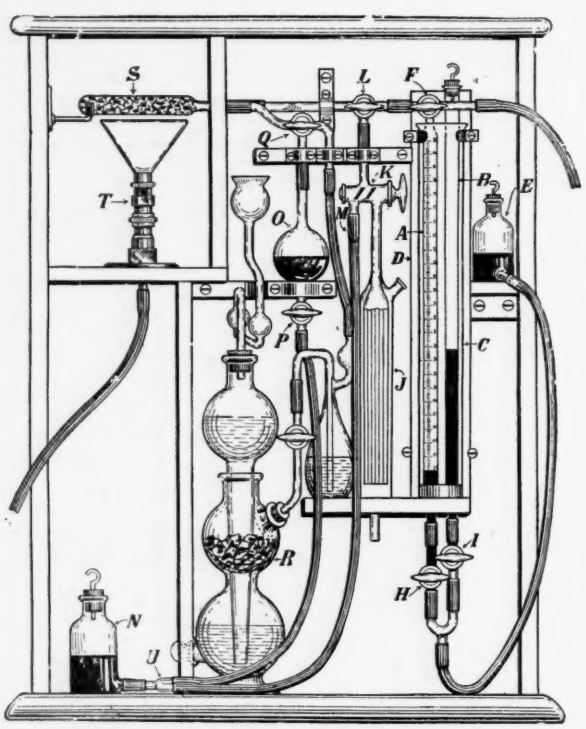


Fig. 4.—Taplay's Combustion Gas Analyser.

The alternative to explosion which commends itself to me is the use of a gas analysis apparatus in which water or brine as containing liquids are absent, in which air is absent, and in which the analysis is effected, not by explosion (which entails the use of air or oxygen), but by "combustion" over cupric oxide. There are several instruments of this type; but the one with which I am best acquainted, and in which accuracy on every point is safeguarded, is the combustion gas analyzer, designed by my friend Mr. J. G. Taplay, in which mercury is the containing fluid. The combustion is effected by passing gas over heated cupric oxide, the degree of heat of which is arranged successively (without any fine adjustment being necessary) for the oxidation, firstly of the hydrogen, and secondly of the methane. It is known, of course, that at a dull red heat cupric oxide only oxidizes hydrogen and at a bright heat oxidizes methane. As the apparatus is filled with carbon dioxide the residual nitrogen present after the above oxidations is that contained in the gas, and is measured in the burette, and not by difference. These are the simple principles which Mr. Taplay has utilized in his combustion analyzer, for details of the manipulation of which I refer to the "Journal of Gas Lighting" for April 23 and 30 last.

For ascertaining the carbon value of the hydrocarbons, the following are the principles. When gas is subjected to bromide what is absorbed is generally assumed to be ethylene (C_2H_4). As a matter of fact, the olefines might, and usually do, consist of propylene and even richer hydrocarbons. It will be seen that as the calorific power depends upon the carbon density (see Table III.), a knowledge of the exact carbon index is a guide to the gas maker as to his carbonization; for 3 per cent. of $C_{2\cdot5}H_5$ is of more value than 3 per cent of C_2H_4, besides which it enables him to check his calorific power. I need not here deal with the method of making this determination. It is absolutely simple, and is made upon gas from which none of the other constituents have been removed, but the percentages of which are known. It will suffice if I confine myself to showing, by means of formula, how the determinations of hydrogen, methane, nitrogen, and carbon density are made.

Let A = total volume of residual gas.
B = volume of residual gas taken for H_2, CH_4, and N_2.
C = contraction after combustion at dull red-heat.
D = amount of nitrogen after combustion at bright red-heat.
E = per cent. volume of benzenes ascertained by absorption.
F = per cent. volume of olefines ascertained by absorption.
G = volume of original gas taken for carbon density test.
H = volume after such combustion.
J = per cent. volume of CO_2 ascertained by absorption.
K = per cent. volume of CO ascertained by absorption.

Then $\frac{C \times A}{B}$ = per cent. volume of hydrogen = L. (*Q.E.F.*)

and $\frac{D \times A}{B}$ = per cent. volume of nitrogen = M. (*Q.E.F.*)

and A − (L + M) = per cent. volume of methane = N. (*Q.E.F.*)

and $\frac{H \times 100}{G}$ = per cent. volume of gas after carbon density combustion = P.

then $P - \{J + 6(E) + K + N + M\}$ = per cent. volume CO_2 from combustion of olefines = Q.

and $\frac{Q}{F}$ = the carbon density of olefines. (*Q.E.F.*)

The whole analysis, including the carbon density determination, is much more rapid than the ordinary method, but the great point is that it is accurate.

Were it not for the fact that the subject I have dealt with involves so many considerations, I should apologize for the length of this article; but, as it is, I trust it may serve the purpose I have had in mind in making it—viz., to induce investigation and discussion.

Coal-Naphthalene Briquettes.

In the "Journal" for the 3rd inst. (p. 813), we reproduced from "Engineering" some remarks on the production of coal-naphthalene briquettes. The following particulars of the process were translated by our contemporary from an article by Grahn in a recent number of "Glück Auf:" The naphthalene is melted outside the mixing-machine, and is then vaporized by superheated steam before it enters the machine. The melting is effected in a boiler in which the naphthalene is heated by a coil through which steam flows at ordinary pressure. The fused product passes through a measuring apparatus which is jacketed, and then goes in measured quantities into the superheater coil, which is placed in the superheater cylinder, and there surrounded by steam at 250° or 300° C. (480° or 570° Fahr.). The naphthalene vapour and the steam, so far separated, enter the nozzle of an injection apparatus, in which a pressure of about 60 lbs. absolute and a temperature of 250° C. are maintained. The vapours pass into the lower stratum of the mixture of coal dust and pitch in the mixing and kneading machine, and the operation should be so regulated that the naphthalene is well distributed throughout the mass, but does not escape as vapour. The Blankenburg Colliery has given the following particulars: They had so far added 6¼ or 6½ per cent. of pitch to their briquettes, for which they had to pay 38s. per ton. The naphthalene cost 47s. per ton; but with an addition of 0·3 per cent. of naphthalene, the required pitch percentage was reduced to 4½ or 5 per cent., so that a final saving of about 6d. per ton of briquettes was realized. The steam is utilized after leaving the apparatus. An addition of more than 0·3 per cent. of naphthalene is not advisable, as it makes the briquettes stick to the plungers of the press.

STATISTICS OF WORKMEN'S COMPENSATION.

THERE were lately noticed in the "JOURNAL" (p. 735) some particulars from the first part of the Home Office Blue-Book for 1911 dealing with the Workmen's Compensation and Employers' Liability Acts. Statistics were then given as to the compensation paid under the Compensation Act of 1906 in seven large industries. The second part of the Blue-Book, now to be noticed, has reference to the general administration of the 1906 Act and the Employers' Liability Act of 1880—the details being separately compiled for England and Wales, Scotland, and Ireland.

In England and Wales, the number of cases actually dealt with during 1911, under the Workmen's Compensation Act, 1906, by County Court Judges and County Court Arbitrators was 5730, as compared with 4848 in the previous twelve months. In addition to these, however, there were 2287 cases that were withdrawn, settled out of Court, or otherwise disposed of in such a way as not to enable the officials of the Court to state definitely the results—making the total number of cases taken into Court, under the 1906 Act, 8017, against 6666 in 1910. Then, besides the cases under this Act, a small number outstanding under the earlier Acts were also dealt with; there having been 103 taken into Court. Confining ourselves to the Act of 1906, the cases actually dealt with by the Courts included 4587 original claims for compensation; and of these, the decision in 3673 cases was in favour of the applicant, and in 814 in favour of the employer. The proportion of cases in which the applicant was successful was 82 per cent., or the same as in the previous year. In 1393 cases the compensation was awarded on account of death; and in all except 15 of these cases the deceased had left dependants. Excluding the latter, the total amount of compensation awarded was £234,276, or an average of £170 per case. Included in the number, however, there were 545 cases of partial dependency, in which sums of less than £150 were awarded; the total amount involved being £39,689, or an average of nearly £73 a case. As to grants of compensation for injury, there were 793 cases in which the compensation was returned as consisting of a lump sum, and 1487 in which a weekly amount was assigned. The average amount of the compensation was £27 4s. 1d. In cases in which a weekly payment was awarded, the average compensation was 11s. 11d. for cases of total incapacity, and 9s. 11d. for those of partial incapacity. In 157 cases, the compensation was claimed for incapacity due to industrial disease. The cases taken into Court in 1911 are as usual classified under seventeen heads; the list and the number of cases under each head being as follows: Professional employments, 41; commercial occupations, 21; shop assistants, 196; domestic servants, 534; seamen, 431; fishermen, 24; agriculture, 367; building, 808; factories and workshops, 2432; docks, wharves, and quays, 326; mines, 1833; quarries, 73; constructional work (not building), 156; railways, 149; inland transport by road and water, 541; miscellaneous, 85.

In 22,940 instances memoranda were registered in the County Courts (having reference to cases settled by agreement, by committees, or by arbitrators); but they represented only a small proportion of those in which compensation was settled by agreement. In these cases, the average compensation to dependants in connection with fatal accidents was £175; and the average weekly payment in cases of incapacity, 13s. Where a lump sum was decided upon in cases of incapacity, instead of a weekly payment, the average was £35 6s. 5d. There is a table comparing the different occupations in connection with the average amount agreed upon; and in this quarries head the list, with £91 2s. 4d. For factories and workshops, the figure is £34 11s. 4d., as against an average of £40 9s. for the previous year.

The statistics with regard to the Employers' Liability Act are dealt with as nearly as possible upon the same lines as those of the Workmen's Compensation Act. They are, however, simpler, because all cases except those removed to the High Court are decided by the County Court, and because the damages awarded can always be stated as a lump sum. Of the 63 cases under the Employers' Liability Act in 1911 in which judgment was given for the plaintiff, only one was a fatal accident; the compensation paid being £40. There were 27 cases involving total incapacity; the compensation awarded being £1744, or an average of £65 a case. In the remaining 35 cases of partial incapacity, the compensation was £1995, or £57 per case. Judgment was entered for the defendant in twelve cases, and 95 are referred to as having been "otherwise disposed of." Thus there was a total of 170 cases under the Act last year. In seven of this class, though the proceedings were originally taken under the Employers' Liability Act, the question of compensation was actually determined under the Compensation Act.

During last year the number of cases carried to the Court of Appeal in England under the Workmen's Compensation Act was 141 (as compared with 136 in 1910), or just over 2·6 per cent. of the cases decided in the County Courts. Of these, 57 were appeals by workmen, and 84 by employers. The successful appeals were 13 by workmen, and 31 by employers; while 33 were abandoned, withdrawn, or settled out of Court before hearing. There were twelve appeals to the House of Lords; the workman being the appellant in seven cases, all of which were unsuccessful. There were no appeals in actions under the Employers' Liability Act. Out of 101 cases under the Compensation Act where the point on which the appeal arose is known, 44 turned on the meaning of the words "accident arising out of, and in the course of, the employment," in section 1 of the Act. In six actions, the definition of the word "dependant" was the point to be decided; and in two others, the definition of the word "workman."

As to the Scottish returns, the number of cases taken into Court in 1911 under the Compensation Acts was 1830 (compared with 1533 during the previous year); and under the Employers' Liability Act, 50. The average amount of compensation paid in cases of death where dependants were left was £135 16s. 1d. in cases decided in Sheriffs' Courts under the Compensation Acts, and £175 5s. 5d. where memoranda were registered. In cases of incapacity, the lump sum figures were respectively £12 16s. 3d. and £14 9s. 11d.; and the weekly payments given were 12s. 4d. and 12s. 10d.

In Ireland, there were 1235 cases taken into Court under the Compensation Acts (compared with 1044 the previous year); and three under the Employers' Liability Act. The average amount of compensation in cases of death where dependants were left was £120 13s. when decided in the County Courts under the Compensation Acts, and £139 8s. 11d. where memoranda were registered. In cases of incapacity, the lump sum figures that were awarded were respectively £44 11s. and £31 5s. 2d.; and the weekly payments, 8s. 10d. and 9s. 7d.

SOME REFLECTIONS ON THE EVOLUTION OF GAS ENGINEERING.

By F. R. PARSONS, of Exeter.

THOSE of us who have grown up in the atmosphere of gas engineering, cannot fail to be sometimes deeply impressed when we thoughtfully contemplate the wonderful results which evolution has wrought in the realms of gas engineering. In no other branch of science can it be said that progress has been more marked, evolution more definite, or improvements more abundant or widespread. And this does not imply progress in the mechanical sense alone. Much of the resultant progress is attributable (not directly) to mechanical lines of thought—even though the latter may of necessity be ultimately demanded in order to bring about the materialization of this state of evolution; but to the analyst, chemist, and experimentalist is due a great measure of the changes from old established rule-of-thumb methods to the scientifically thought-out lines under which various problems connected with the gas engineering industry are dealt with to-day.

It is a well-proved axiom that one failure teaches more than a dozen successes. A failure proves the existence of a flaw in our reasoning, and accentuates the need for a revision of our established hypotheses. Out of failures is born progress—the stepping-stone to evolution. New mechanical laws are formulated, obsolete reasoning swept away, prejudices overcome, old conditions supplanted by new—all this being inevitable, as long as the human mind refuses to be satisfied with old traditions and remains fast in deeply-indented grooves, worn easy of travel by our forebears.

Yet, despite the inevitableness of this transition, there are, and always will be, those who will never accept, until demonstrable proof has been afforded them, that such evolution is not only in the end advantageous, but absolutely necessary. The unshaken confidence and tenacity with which they cling to obsolete methods is only equalled by their confirmed unwillingness to accept anything approaching the unorthodox. But as generations go by, there enters with the new era a different race, more amenable, more ductile, with a mind more attuned to innovation, more open to conviction, less hampered with old-time fetishes, traditions, and prejudices. This, of course, is more the result of environment and experience than of temperament. With each succeeding generation must come increased adaptability, a more open mind, a lessened adhesion to the orthodox.

In our case, we can trace this evolution right back from those very early times when illumination was produced direct from the material consumed—such as a resinous piece of pine, the fat of a dip, the oil of a lamp, and so on. Then came the production of light from carbonaceous matter—the real evolutionary step. And so we might follow its progress first down to the present day, noting, *en route*, the introduction of the mechanical arts as applied to the process, until we reach the present era in which manual labour is almost entirely displaced by mechanical agencies. We might note the introduction of the first mechanical charging and discharging machine, the application of the elevator and conveyor, the mechanical washer and scrubber, the coal and coke handling plants, and the hundred-and-one mechanical devices which, by their aid alone, have made so valuable all the residuals and bye-products hitherto despised and neglected by our predecessors. Through the long vista of years, we can trace the finger of evolution for ever pointing ahead into the unseen, the unrealizable, the unfathomable. Yet it must be admitted that we are prone sometimes to think there must be a limitation to this avenue of progress; that the day must come when man's finite mind will call a halt to evolution's inexorable laws; that his mind will not conceive anything being possible beyond what is. But we forget that, when this day apparently arrives, our inheritors will be looking at the other end of evolution to that on which we are looking

to-day. We are now looking at the accomplishment; they at the beginning of an era.

What would be the thoughts of Murdoch, Lebon, the brothers Clegg, Winsor, Taylor, and Martineau, could they now step into a modern gas-works and note the many undreamed-of operations which they were unable to foresee, or ever thought would be called for? The first named doubtless saw only one thing left undone towards the accomplishment of a scheme which to him seemed to have reached an ultimate finality; and that was the detail which was left for the brothers Clegg to accomplish—viz., that of purification. Indeed, it is on record that William Murdoch, after successfully installing his first gas-works, declared that, within the space of a few short months, he had achieved what a century's ordinary rate of progress would never equal. But then he had died before the beginning of the last century of evolution had really begun! All which goes to show the vast difference in man's conception of evolution then and now.

Having got thus far, the question now arises, Have we any claim, in the face of what a century has done towards the evolution of gas engineering, to echo Murdoch's opinions as to finality? Unquestionably, no. But, at the same time, there may be this to consider. While the next hundred years may not witness the same pronounced improvements—inevitable because this span of years really covers the inception of the gas engineering industry—there will undoubtedly be as many sweeping changes, though perhaps not in the character of innovations, owing to the broadening of economic laws, the ever-widening scope of operations, and the extending of utilitarian principles—in other words, the intense desire to create a useful commodity out of that which has hitherto been considered worthless material. The law of economics teaches us that nothing, not even human labour, must be wasted. Undeniably, upon these lines will science direct her energies more assiduously during the coming century.

This is brought home to us with forceful directness, when we consider that at the present rate of progress it is a matter of something more than mere speculation whether we shall not soon reach the period when our existing storehouses of raw material, from which we are at present drawing at a rate unprecedented, and the filling of which has taken thousands of years, will become, if not exhausted, then perilously depleted. This alone will be a compelling factor why science will have to come to the rescue, and devise means whereby these resources must be more carefully conserved, and the elimination of all waste a feature to be studiously regarded.

I have mentioned mechanical evolution as playing a not unimportant part in the general evolution of the industry under review. Perhaps it is not too much to say that, without the medium of such an expansive agency, all the thought and energy directed upon the subject, all the "arm-chair" science, as it has been frequently termed, would have availed nothing in the onward march of progress. The real factor has been the practical man, through whose skill and ingenuity have been fashioned fingers and arms of steel, reliant, enduring, untiring, yet subservient and obedient to the will of man. The human agency has a limit beyond which it is impossible to go without fear of a breakdown. The man-created substitute has no such limit. Its work is never dependent on the amount of rest it obtains, its operations are unfailing, consistent, and methodical. By displacing human hands, more regular systems can be secured, and more efficient results obtained, at a decreased cost in human wear and tear.

It may be put forward, however, that what we have gained by mechanical evolution we have lost in other ways, primarily owing to this displacement of labour. To this I answer, of what use is evolution, if not to make the paths more smooth and less arduous for the human toilers? Every mechanical device, while seeking to ensure a greater degree of certainty and reducing the element of chance inherent in every manual operation, tends to lessen the drudgery of human toil. Is it not far easier to manipulate the levers controlling a charging machine than to shovel coal, at the expense of much brawn and muscle, into a retort? And, if a certain amount of "bullock" labour is actually displaced, the law of human gravitation inevitably brings the unit, through economic changes, back to a newer and better level.

Now, what would be a fitting summary to this very short review? Would it be a pæan of praise to those who, by their mechanically-trained efforts and practical minds, have raised the science of gas making to a level on the mechanical plane equal in precision, efficiency, and economy to that of other branches of engineering? Or must the palm be accorded to those thoughtful "arm-chair" scientists whose mission it is to undermine the surface, whose analytical studies have made valuable that which hitherto has been without value, and who have prepared the soil for their more practical brethren to build and construct appliances wherewith to cope with the ever-increasing demands for something more reliable and less costly than hand labour?

These are questions best left to individual criticism. For the writer's part, while somewhat hesitating to differentiate between the merits of either, he—being a practical man—will be pardoned if he admits that he entertains a certain decided inclination to the former.

CONTINUOUS CARBONIZATION IN VERTICAL RETORTS ADOPTED AT NOTTINGHAM.

A Glover-West Installation at the Radford Works.

Operations now in progress at Nottingham are destined to effect some striking changes locally in relation to methods of gas production. Approximately £26,000 is being expended upon the installation of the new Glover-West vertical retort system at Radford—one of the branch carbonizing stations. The new plant is designed to afford an output of 1½ million cubic feet of gas daily; but the whole scheme, when completed, will represent a producing capacity of from 3 to 3½ million cubic feet, with a correspondingly increased outlay—the total possibly not falling short eventually of between £50,000 and £60,000. The works at the Radford depôt illustrate the truth of the axiom *Ce n'est que le premier pas qui coûte;* and the first step having been taken, after deliberation the rate of which cannot be said to have erred upon the side of express speed, the process of bringing a small portion of Nottingham's works to an up-to-date standard is now proceeding apace.

The hastening-slowly policy has had advantages, inasmuch as Nottingham advisers have had the opportunity of testing the worth of methods which have gone beyond the experimental stage. Visits by Sub-Committees and responsible officials to France, Germany, Austria, Belgium, and Holland have formed the prelude to many important improvements undertaken in recent years. The outcome of one of the first excursions, to Paris and Bruges (upon which occasion the Committee of Inspection consisted of the then Chairman, Mr. E. Harlow, Alderman J. P. Ford, Alderman Fleeman, Mr. J. H. Brown, the former Engineer, and Mr. F. B. Harris, the Solicitor to the Corporation), led to the adoption at Eastcroft of the De Brouwer conveyor. In quest for information as to vertical retorts, a subsequent official itinerary included an examination of the installations at Mariendorf and Potsdam, Cologne, Dortmund, and Brussels; the present Chairman of the Committee, Alderman A. Ball, having on this occasion the company of Alderman Jelly, Mr. Brown, and Mr. Harris, as also of Professor Heaton, the Principal of the University College. Independent visits by the Chairman and the Engineer followed to Vienna, Königsberg, Zurich, Amsterdam, Rotterdam, and elsewhere. So that it cannot be suggested that the full Committee, in making a final recommendation, had other than ample data. Careful examination of the appliances, followed by scrutiny of the results submitted by the Engineers of the several works, left no doubt in the minds of the Committee that the German system of carbonization in vertical retorts was by far the most successful and economical method for the production of coal gas. At the same time, the unfortunate condition was recognized that by this system considerable difficulty was experienced in producing gas of sufficiently high illuminating power to comply with the standard to which the Committee were then working. Yet the fact was pointed out that where incandescent gas-burners are generally in use, the gas produced by this plan was quite adequate to meet all requirements; and in pinning their faith to the adoption of vertical retorts, the Committee of Inspection had the unmistakable evidence that in every important Continental city where enlargements had recently taken place in the gas-works plant, vertical retorts were found in operation. Moreover, emphasis was laid by the Committee upon the consideration that by this system the heating value of the gas is quite equal to that produced by horizontal or inclined retorts.

During the Continental tour, the Sub-Committee also availed themselves of the opportunity of inspecting the more recent installation of the system of producing gas in large coke-ovens at Vienna, Bochum, and Rotterdam; this plant being almost identical with the coke-ovens which during the preceding four or five years had been installed at nearly every colliery producing bituminous coal. This system, it was further pointed out, permitted of the carbonization of coal in large bulk charges of 7½ tons each.

The Committee were strengthened in their recommendation as to embarking upon the Glover-West system at Radford by the guarantee which the patentees of the plant were prepared to give, both as to illuminating power and the quantity of gas produced per ton of coal—a condition being that, should their guarantees not be fully complied with, the patentees were prepared to remove the whole of the plant at their own expense. In these days of hostile agitation regarding products of foreign origin, it was also not without significance that the tender for the work expressly stipulated that the plant, material, &c., should be wholly of British make.

During the tour of inspection, the Committee also cast an interested eye upon the system for the purification of gas installed at the Königsberg Municipal works; but, while recognizing that the plan is one which is destined to revolutionize existing methods, they did not for the present go to the length of recommending its adoption in Nottingham. Upon the information gleaned during their Continental experience, the Committee had no hesitation in recommending, for reasons of increased efficiency and economical working, the adoption of the vertical system of retorts.

Five or six months may yet elapse before the installation of the first section of the new Glover-West plant is completed; and meanwhile there is, as is not unnatural, some reluctance in official quarters as to dealing with the matter in detailed form. The feeling finds expression in the idea of the inutility of an article apart from demonstrable facts as to actual outlay and the possible saving which may be ultimately involved. But as June, 1913, is a long way off, some preliminary facts may be related—leaving the fuller and necessarily valuable technical data to a later period.

The site of the new installation has hitherto formed the least important of the Nottingham gas depôts. Only a small portion of the equipment has been utilized there in recent years, the place being in the nature of a "stand by" to which recourse could be had in the event of emergencies, when other means of supply might be temporarily dislocated; and the works, being thus in a state of partial desuetude, naturally formed the most adaptable centre at which to embark upon the scheme. The Radford plant, established on a site not far distant from colliery workings and contiguous to a branch of the Midland Railway, forms quite an antique link in the chain of Nottingham's gas arrangements. The oldest generating station is at the Eastcroft, which was the source of the illuminating power long before the advent of railways now crowding that part of the town. But the main expenditure since the Corporation assumed control has been at Basford, on the western side of the city—the development here, as in other directions, being illustrative of that which has occurred in numerous cases in other large centres in which private interests have been bought up. That Nottingham effected a tolerably satisfactory bargain with the holders of shares in the original gas undertaking experience has proved, for it becomes annually apparent to what an extent the district rate might be increased save for the possibility of drawing upon gas profits—this process being pursued in a ratio the equitableness of which, in the interests of gas consumers, has given rise to seriously conflicting views. Whatever the varying considerations may be on this head, it is clear that alleviation of rateable burdens has not been afforded at the risk of financial stability; for Nottingham's gas reserve funds, amounting to 40 per cent. of the total capital involved, will compare favourably with those of any similarly large undertaking in the country.

Incidentally to the use of the profits, questions of an important character have arisen as to the treatment of consumers living beyond the municipal area. There are many outside districts supplied in which the contingent risks are aggravated, mainly, by the circumstance that the mains have to be carried through places honeycombed by colliery workings. Under the statutory obligations devolving upon the Corporation, no preferential treatment is possible. The price charged to the extra-municipal consumers must be the same as in Nottingham itself. Herein, as the case presents itself to the official mind, lies the difficulty of any immediate material reduction of rates in the city, seeing that the Corporation, being rigidly precluded by the statutory enactments from exercising differential treatment, the outside areas would, in the event of a diminution in prices, share alike in the benefit—the necessarily obvious objectionable element in such a plan being that inhabitants of country places, while in no way responsible for the great financial liabilities of the undertaking, might yet claim an equal share of the stake at issue. The outside consumers, meanwhile, remain very obdurate in the matter; the latest evidence of their demands being furnished within the last few days by the action of the Eastwood Council, representing a community situate in the midst of an extensive colliery district a few miles from Nottingham. They originally conceived the idea of inviting the co-operation of other public bodies who are gas consumers in the neighbourhood to make application to the Corporation for a participation in the profits made annually out of the gas undertaking. Certainly the proposal did not err on the side of modesty—a contingency which even the Eastwood people themselves at length realized, when they amended their case to one of appealing for a reduction in the price charged rather than any rebate upon the total consumed. With the idea of enforcing this claim, efforts are now being made to obtain the assistance of the Awsworth, Basford, Beeston, Brinsley, Carlton, Greasley, Hucknall, Kimberley, and Bridgford authorities, who are also among the customers.

Viewed from the Nottingham standpoint, the idea of those represented by this attempted combination appeared at first sight to be so ill-founded that it might be ignored. But it having gone beyond this stage, significance attaches to the notice which has been given to the subject in a speech delivered only a few days ago, at a meeting during the progress of a municipal bye-election. Sir John T. M'Craith, who is the leader of the majority in the Council, dealt then with the subject in very plain terms, characterizing the claims of the District Councils as being absolutely absurd, unjust, and unfair. He went further, and declared that, if he had his way, having regard to the fact that the whole financial responsibility devolved on the Nottingham Corporation, the outside consumers should pay more than they are at present charged. Obviously, the matter is not without its interest to corporations apart from Nottingham.

It was in 1874 that a discriminating bargain was effected, whereby the Nottingham Council acquired the interest of the old Company who for 56 years previously had possessed the monopoly of gas supply; the salient feature of the arrangement being the creation of annuities entitling each of the shareholders to receive £3 2s. 6d. per £100 for the first seven years after the acquisition and £3 5s. thereafter. Indicative of the financial stake which is involved by the City's possession of the concern, it may be mentioned that the total capital to-day is £1,079,556, made up of: Total annuity capital, £318,900; loan capital, £230,667; debentures, £55,520; consolidated stock, £474,468. Great developments of supply naturally followed the extension of the borough boundaries in the year 1878. Previously, Nottingham, as a separate municipal entity was of very attenuated proportions, consisting of a circumscribed area immediately surrounding the Market Place. With the inclusion of Basford, Bulwell, Lenton, Sneinton, and other previously independent parishes, there ensued inevitably an enormous increase of municipal responsibilities in regard to which the gas undertaking played a main part.

Although much had been done to improve the equipment there, the Eastcroft and Radford works were quite inadequate to meet the enlarged needs. A new gasholder and an electric coke conveyor were installed at Eastcroft works, where also inclined retorts were established to take partly the place of some of the horizontal type—the dictum being acted upon regarding this part of the matter that the greater cost is compensated for by the higher yield proportionate to the floor space involved. At Radford also some improvements were effected; but it was at Basford that the principal expenditure, represented by £150,000, was involved by the creation of new and extensive works, completed in 1883—bringing the plant up to the then best known means of efficiency. Now, after nearly thirty years, under a new managerial *régime*, further evidence of enterprise is being afforded, significant of the intention to bring the local plant into the front line of efficiency. There has up to the present time been a great deal more work done at Radford than is visible above ground; huge excavations having had to be effected.

Coincidently with Mr. John Wilkinson's appointment as Engineer and Manager, has come the acceleration of these operations. His predecessor's participation in the matter, apart from the inspection at Continental centres, was limited to a recommendation merely as to experimenting with the vertical system, and it devolved on Mr. Wilkinson to set the work going, he having paid several visits, in company with Alderman Ball, to places at home at which the vertical system is in vogue. Apart also from the journeys, which have been previously enumerated, it may be mentioned, in illustration of the thoroughness of the preliminary investigation, that there were few large or important European gas-works which Alderman Ball had not himself visited. Thanks to Mr. Wilkinson's courtesy and that of the Chairman of the Committee, a visit of a representative of the "JOURNAL" to the Radford depôt, in company with Mr. W. Gregson, the Engineering Assistant, was rendered possible a few days ago. By way of preliminary, it may be observed that while one never expects to find gas producing plant placed amid roseate bowers, the environment of the Radford equipment is about as deadly uninviting as could be imagined beyond the confines of a Serbonian bog. Wollaton Hall, one of the finest examples of Elizabethan architecture of which England can boast—next probably to Hatfield House—lies not far away; but the perspective from Lord Middleton's Nottingham demesne has been sadly marred by the "houses in between."

Reference to the historic building revives the recollection (which is not altogether inapposite to the present article) that the great wall surrounding Wollaton Park was brought upon the backs of mules from the famous Ancaster quarries in Lincolnshire, in exchange for coal taken from the Wollaton pits. Now the process is reversed in relation to the material used for gas making, in that the main supply comes from outside quarters. Considerable quantities of cannel from the Babbington, Clifton, and Wollaton pits are employed, but for the main purpose of supply, although there is great mineral wealth in the district, the Corporation find it desirable to look beyond the confines of Nottinghamshire—drawing largely upon Yorkshire, Derbyshire, and other sources. Obviously when it is a question both of the best carbonizing qualities and of residuals obtained—residuals last year representing an income of over £80,000—local considerations must go by the board, albeit there are those who argue that, with a judicious admixture, a greater quantity of local coal might without disadvantage be used.

To close this week's instalment of our article, it may be mentioned that the works now being carried out by West's Gas Improvement Company, Limited, under the resident direction of Mr. R. B. Glover (Mr. West himself paying frequent visits to Nottingham), were begun only about three months since, but already excellent progress has been made. The whole of the foundations have been put in, the pier wall is ready for receiving the joists to carry the retorts, and the fire-clay material is well in hand. So that the completion of the contract by the stipulated time (the end of June next) may be anticipated—the utilization of the new plant a few weeks from Midsummer being thereby brought within range of possibility.

(*To be continued.*)

"Competition Points for Gas Salesmen."—By an oversight, an error that appeared in Professor Lewes's Dublin lecture was transferred to p. 93 of "Competition Points for Gas Salesmen." The headings of the tables on that page should, of course, read "Carbon Dioxide—Parts per 100." In the copies that are now being sold, the correction has been made. The same correction will also apply to the tables as printed in the volume of the "Transactions" of the Institution of Gas Engineers in which the lecture was published.

PEAT FUEL FOR THE PRODUCTION OF POWER.

In the last number of the "JOURNAL," we gave some extracts from the first part of the report of Mr. B. F. Haanel, B.Sc., the Chief of the Fuel-Testing Division of the Canadian Department of Mines, on his experiments on the utilization of peat for the production of power. We now deal with the second part.

In his introductory remarks, Mr. Haanel states that the trials previously described demonstrated that, with the producer and cleaning system as originally designed and constructed, it was impossible to obtain a gas sufficiently free from tar to permit the engine to operate many hours without cleaning the cylinder and valves. It was also shown that the operation of cleaning could be performed while the engine was in motion, without in any way interfering with the load. But while the plant could be run for an indefinite period without having to shut-down for purposes of cleaning, efforts were made to discover the seat of the trouble, and, if possible, to correct it. The results of the many trials conducted by the writer and his technical staff tended to point to a faulty construction of the producer itself; and, on the strength of the deductions made from the observations, certain changes were recommended to Messrs. Körting Bros., of Hanover, the manufacturers of the plant.

With the view of assisting them in their efforts to eliminate the tendency to the formation of tar in large quantities, the Mines Department sent to Hanover ten tons of the peat manufactured at the Government peat plant at Alfred, already referred to. After a lengthy investigation of the behaviour of this peat under varying conditions in a similar producer erected in their shops, they reported that they had succeeded in obtaining a gas free from tar, on which the engine could operate for many months without cleaning.

IMPROVEMENTS IN THE PLANT.

To accomplish this result, the engineer-in-charge deemed it advisable to alter the shape of the lining of the producer, because the contracted neck did not offer sufficient resistance to the passage of the gas down it to the offtakes; and hence, instead of operating as an up-draught in the upper zone, it acted partially as a down-draught. In order to overcome this difficulty, the contracted neck was made much longer; thus increasing considerably the resistance to the passage of the gas through this channel. The cleaning system was also altered.

Even with these alterations, the producer, though undoubtedly improved, failed to deliver a gas sufficiently free from tar to permit of more than a few hours' operation of the engine before it became necessary to clean the valves and cylinder, to prevent sticking; and the old remedy of washing with oil-soap and water had to be resorted to.

The trials made by the expert sent by Messrs. Körting from Germany did not prove satisfactory as regards the generation of a tar-free gas; consequently, a series of tests was conducted by the technical staff of the Fuel-Testing Division, at the expense of the firm, for the purpose of ascertaining the cause of the trouble, and, if possible, discovering some means of correcting it. As a result of many trials made with the producer in its original and in its altered state, it was concluded that the tarry components of the gas evolved in the upper zone could not be entirely burnt or split-up into permanent combustible gases; and for this reason a special method of cleaning the gas was resorted to, in order to overcome the difficulty.

After considerable experiment, Mr. Haanel succeeded in devising a cleaning system which effectively separated the troublesome tarry matter from the gas; so that, irrespective of the behaviour of the producer itself—*i.e.*, whether it operated as down-draught or up-draught, with large or small air openings—the gas at all times was sufficiently clean to offer no obstruction to the normal operation of the gas-engine. While under the original construction it was necessary to remove and clean the mixing or the admission valves after a few hours' run, and even the piston after a few days, it was possible, under the new conditions, to run for many days before it became necessary to clean either the mixing or the admission valves; and it was considered that the piston should not require cleaning more than once or twice a year if the plant was operated continuously.

Having described in detail, by the aid of large diagrams, the alterations made in the producer and the cleaning system, Mr. Haanel explained the purpose of lengthening the contracted passage between the upper and lower zones, and described the effect of the alterations. He says that while the producer, in its changed form, could not deliver gas free from tar, its action had been manifestly improved. Its operation was more uniform, and the amount of solid material possessing a high heating value which it was necessary to separate out in the coke-scrubber was materially decreased, and at times was scarcely noticeable. The main difficulty, however, still existed as in the old form of the producer—viz., the formation of a variety of tar—as a thin liquid when condensed, and as finely divided particles carried in a state of suspension after passing through the cleaning system. This objectionable bye-product could not be obviated in the producer itself, but must be separated out mechanically. To accomplish this, the makers of the plant devised a special addition to the coke-scrubber; but it failed to accomplish the desired result. Thereupon Mr. Haanel invented a remedial device which completely removed the troublesome matter from the gas; and with this alteration the plant was, he says, an unqualified success.

Mr. Haanel next gives a description of the improved coke-scrubber, and describes the experiments made to arrive at a method for effectively separating the tar fog from the gas. As the result, a separator was devised by him which proved to be very efficient, entirely dependable, and capable of being operated for any period without clogging, and therefore without producing increase of the suction.

On the completion of the alterations to the producer and gas-cleaning system, twenty-six trials were carried out, of which fourteen are described in detail in the report. The first were made with the object of examining the performance of the producer, and they were carried out in accordance with the instructions of the makers. The remainder were undertaken for the purpose of examining the behaviour of the producer under varied conditions, and with a view to decreasing the amounts of tar in the gas leaving the cleaning system. In addition to the equipment used during the tests previously described, there were installed one of Smith's recording gas calorimeters, a Bristol recording pyrometer, a Thwing three-record pyrometer, and a Sargent apparatus for determining the amount of tar in a gas. The first-named instrument makes a record of every variation in the gas caused by poking or by the formation of air spaces in the producer; and Mr. Haanel says it constitutes "a valuable adjunct to the observation instruments usually found in engine-rooms, since the change in the heating value of the gas is perceived at once, and can be rectified by the producer attendant."

TESTS WITH THE IMPROVED PLANT.

The results of the tests are set forth in a number of diagrams and summaries, as well as in complete test-logs appended to the report. The first test made after the reconstruction of the producer was started at 11.30 a.m. and finished at 9.30 p.m. on Sept. 19, 1911. Owing to the presence in the gas of tar which deposited on the walls of the cylinder, causing the piston to pound, it was found necessary to wash the cylinder with a mixture of oil-soap and water at 2.15 p.m. and again at 7.20 p.m. For a similar reason, the cylinder was well oiled at 8 p.m. At the end of the trial, the valves were examined, and found to be fairly clean. Before replacing, they were thoroughly cleansed. During the entire trial, the wash from the coke-scrubber remained conspicuously clean. Apart from the deposit of tar in the cylinder of the engine, the operation was quite satisfactory.

The next trial was made under precisely similar conditions, but was of twice the duration. There was practically no change in the results—the economic figures obtained in both trials being almost identical. The trial lasted from 10.10 a.m. on Sept. 20 till 6.10 a.m. on Sept. 21. As in the previous trial, trouble was experienced with tar in the cylinder, which caused the piston to pound. To remove the deposit, washing with oil-soap and water was resorted to. The valves were removed at the end of the trial, and were found to be covered with a thin tarry deposit, which, however, did not cause them to stick during the run.

The following are summaries of the results of these two trials:

	(1)	(2)
Total peat charged	1250 lbs.	2450 lbs.
Total dry peat charged	858 ,,	1710 ,,
Average kilowatts delivered to switchboard	35·3	35·2
Average B.H.P. of engine	53·8	53·7
Gas delivered to engine per hour	4590·0 c. ft.	4520·0 c. ft.
Do. per B.H.P. per hour	85·0 ,,	84·0 ,,
Heat equivalent of gas delivered per B.H.P. per hour	9660 B.Th.U.	10,100 B.Th.U.
Producer efficiency	63·8 p. ct.	66·8 p. ct.
Thermal efficiency of engine (B.H.P. basis)	26·3 ,,	25·2 ,,

A trial made on Oct. 24, 1911, was run at two-thirds load, or 40 H.P., with the peat manufactured at the bog of the Industrial Peat Company, Limited, Farnham, Quebec. Ten tons of the peat were shipped to the Fuel-Testing station for the purpose of investigating its behaviour in a gas-producer. It was of excellent quality, and the moisture content (27·8 per cent.) was within the limits prescribed by the makers. The trial was commenced at 9.30 a.m. and completed at 7.30 p.m. The air openings in the doors of the lower zone were varied from time to time, in order to observe the effect on the formation of tar. From the beginning of the trial until 2.50 p.m., the sum of the areas of the openings in the bottom doors amounted to 2·8 square inches, which was increased at 2 p.m. to 6·6 square inches, and at 5.30 p.m. to 10·8 square inches. The cylinder was washed out before starting, and again at 1 p.m., in order to free it from tar. Upon stopping the trial, the cylinder was found to be clean. A rise in suction at the producer exit towards the end of the trial was due to a layer of clinkers about an inch thick, which had formed over the grate-bars. The following are some of the results of this trial:

Total peat charged	1102 lbs.
Total dry peat charged	794 ,,
Average kilowatts delivered to switchboard	27·1
Average B.H.P. of engine	41·3
Gas delivered to engine per hour	3840 c. ft.
Do. per B.H.P. per hour	93 ,,
Do. per I.H.P. per hour	74 ,,
Heat equivalent of gas delivered per B.H.P. per hour	11,500 B.Th.U.
Do. per I.H.P. per hour	9,160 ,,
Producer efficiency	62 o p. ct.
Thermal efficiency of engine (I.H.P. basis)	27·9 ,,

Observations having been made on other trials, Mr. Haanel gives some notes on the operation of the producer from the results obtained, dealing specially with the effect of increasing the air openings. He states that while the gas analyses are insufficient in number to warrant an accurate deduction as to the efficiency of the producer, the efficiencies calculated from the analyses available show a manifest increase when the openings in the lower zone are enlarged. Trials were made with the engine running at three-quarter load. In these the quantity of dry peat consumed per brake-horse-power varied from 1·77 lbs. to 2·16 lbs.; the average consumption being 2 lbs. If a plant were run for ten hours at the above-named load, and then closed-down for fourteen hours, the total consumption of fuel per B.H.P.-hour, including that used for banking, which has been found to be about 3 lbs. per hour, would amount to 2·09 lbs.

From the results of his investigations Mr. Haanel draws the following

General Deductions and Conclusions.

The tests described are divided into two parts. Part I. deals with the tests carried out with the producer as originally constructed. This series of tests showed a good fuel economy, but left something to be desired as regards the cleanliness of the gas delivered to the engine. The deposition of tar in the gas-main and on the valves, cylinder, and piston of the engine, necessitated the cleaning of the parts affected. At the close of the run, it was generally found necessary to remove the valves for cleaning, and to wash the cylinder and piston from time to time during the running of the engine. The operation of cleaning was accomplished by syringing the cylinder and piston with a mixture of oil-soap and water; and while the continuity of the running of the engine was at no time endangered by the presence of tar, the operation of cleaning occupied more of the engineer's time than was considered desirable. In order to obviate this trouble (such as it was), the makers, at their own expense, had the producer reconstructed.

Part II. of the report deals with the tests carried out with the producer as reconstructed, and with the modification introduced by the technical staff of the Fuel-Testing Station. The first of this series of tests showed that tar still reached the engine, in spite of the change in construction; and although a manifest improvement was discerned, it was found necessary from time to time to wash the cylinder and piston as in the previous series of tests. Further tests were conducted in order to observe the effect which changes in the distribution of the air admitted to the upper and lower combustion zones would have upon the production of tar. The results of these tests led, on the one hand, to the abandonment of the idea of totally destroying all the tarry matter within the producer itself; and, on the other, to the necessity of separating the tar from the gas in the cleaning system. After some preliminary experiments, a solution of the problem was found by placing a gauze cone in the top chamber of the coke-scrubber. After the inclusion of this cone in the cleaning system, no further trouble with tar was experienced, and the operation of the plant as it now stands may be pronounced as entirely satisfactory.

The results of the investigation are summarized as follows:

Reliability.—The peat producer gas-power plant, as now constructed, may be pronounced thoroughly reliable. Its operation may be carried on continuously for a week or more without having to shut-down for the purpose of cleaning the valves of the engine. The engine has been operated for a period of 150 hours without removing either the admission or mixing valves for cleaning. It should not be found necessary, in commercial practice, to remove the piston for the purpose of cleaning more than once in six months. The operation of the producer is uniform, and the gas delivered to the engine varies only slightly during a ten-hours' run. The removal of ashes, and the cleaning of the fires can be done without interfering with the operation of the engine, due to a change in the quality of the gas.

Attendance.—A peat producer gas-power plant of the size installed in the Fuel-Testing Station can safely be left in the hands of an intelligent labourer after he has received from a competent engineer for a week or so instructions in the handling of the plant. The services of only one man are required to run the plant when it is operated on day shift work only.

Cleaning of Gas-Pipes, Mains, Valves, &c.—It is recommended that the gas-pipes leading from the producer to the cleaning system and the tar filter be cleaned once a week, if possible, when the plant is run ten hours a day during the working days of the year. If this is done, very little will be required to keep the plant in good condition. The admission and mixing valves of the engine will not require cleaning for two weeks or more.

Fuel Consumption.—The consumption of fuel per B.H.P.-hour, including stand-by losses, is: For full load, 1·7 lbs. of dry peat, or 2·3 lbs. of peat containing 25 per cent. moisture; for three-quarter load, 2·1 lbs. of dry peat, or 2·8 lbs. of peat containing 25 per cent. moisture.

Cost of Fuel.—In estimating fuel costs, the assumption is made that peat with a moisture content of 25 per cent. can be delivered to the producer for $2 (8s. 4d.) per ton. In order, however, to take advantage of this or a lower cost for fuel, the power plant will have to be situated at or near the bog where the peat fuel is manufactured. For small plants of the type and capacity described, this might not prove feasible in many cases; but it will prove entirely feasible and practicable when the plants are of large capacity, and when the energy developed is transmitted, in the form of electricity, to neighbouring towns and villages, for lighting, power, and other purposes. Since the fuel burnt in the producer does not require to be of the best quality, the cost may be considerably reduced, since the broken peat bricks and considerable fines, which always occur in the manufacture of peat, and otherwise represent a loss, can be efficiently utilized in the producer. Assuming, however, that peat can be delivered to the plant for $2 per ton, and that the plant is run with a power factor of 75 per cent. for 3000 hours, the fuel costs would be $8.40 (35s.) per B.H.P.-year, including stand-by losses.

Plant Costs.—The first cost of plant of the type described, in comparison with that of other types, should be left for the consideration of those interested in particular cases, by obtaining competitive prices from manufacturers. Local conditions, capacity of plant, &c., change the first cost so completely that any figures quoted might prove misleading.

Bye-Products Recovery Plants.—In various plants at present utilizing peat for the production of power, the net cost of developing the power is considerably reduced by the sale of sulphate of ammonia and tar, which are recovered as bye-products. This recovery is attempted only in plants of larger size than the one here described.

WIND PRESSURE ON BUILDINGS.

Supplementary to the investigations made in this country on the subject of wind pressure on structures, some interesting experiments by Professor Smith, of Purdue University, were noticed in a recent number of the "Builder." For the purpose of his tests, Professor Smith used a model building erected on an open site, and constructed so that the wall length and height and the roof slopes could be varied to give 27 different combinations.

From a study of the pressure diagrams and curves plotted from the values obtained after correction for measurable errors in the apparatus, Professor Smith deduces the following conclusions: (1) The increase of wall height tends to decrease relatively the average pressure on the windward surface, while the decrease of wall height with unaltered roof height tends to increase the average pressure on the windward wall surface, and cause pressure on the windward roof slope. (2) The increase of wall height tends to increase relatively the average suction on the leeward wall. If the roof is long in comparison with the height, or if the height is small in comparison with the roof span, the leeward suction is relatively small. (3) The increase of height tends to increase relatively the flow of air round the ends of a building. If the building is short in comparison with its height, the flow of air round the ends has more influence than the flow of air over the roof upon the relative pressure and suction on the windward and leeward surfaces, respectively. As the end flow increases, the windward pressure tends to become of maximum value; while the leeward suction at the middle tends to become of minimum value. In view of these conclusions, Professor Smith considers that present methods of estimating wind loads on industrial buildings should be modified. For instance, in the case of roof trusses on masonry walls or on steel framing with long diagonals, he recommends that a suction effect of about four-tenths the unit wind pressure should be taken for the leeward roof slope of all closed buildings, and a pressure or suction effect derived from his curves taken for the windward slope. The resulting stresses will not only differ in amount from those calculated on the customary basis, but in some members will differ in sign. He considers that wind loads on purlins may generally be neglected, or taken at lower values than usual; but he points out that the need for secure anchorage, to guard against the lateral movement and vertical displacement of roofs, is clearly indicated by the results obtained.

Carbonization of Gas Coal in Large Quantities.—This is the subject of an article by Signor D. Meneghini in the "Gazzetta Chimica Italiana." The author carried out a series of experiments to ascertain the probable cause of the difficulty sometimes experienced in discharging the coke yielded by certain coals when carbonized in chamber ovens; and according to an abstract of the article in the "Journal of the Society of Chemical Industry," he found it was due chiefly to the friability of the coke, whereby during the discharging operation it tends to break into small pieces. These impede the movement of the mass of coke when discharging is effected by gravity; while when a machine is used, it tends to crush the coke rather than move it forward. In general, the fragility of the coke appears to increase with the proportion of ash in the coal, especially when this is distributed irregularly. Three lots of Durham coal with which special difficulty was experienced in discharging the coke, all contained upwards of 8 per cent. of ash. The friability of the coke also increases when the coals are exposed for long periods to the air before carbonization; and the proportion of humic acid in the coal increases concurrently. The author recommends that the proportion of humic acid (or matter soluble in 10 per cent. of potassium hydroxide solution) should always be determined in coals which are to be carbonized in chamber ovens. Good gas coals generally do not contain more than 1 per cent. of matter soluble in alkali; and when this limit is exceeded, it is stated that the coal must be looked upon with suspicion in regard to risk of spontaneous ignition, and difficulty of discharging the coke after carbonization in chamber ovens.

CHEMISTRY IN GAS-WORKS.

The first of two lectures on this subject was delivered at University College on Wednesday last, by Mr. W. J. A. Butterfield, M.A., F.I.C., before members and students of the Institute of Chemistry. The second lecture will be delivered towards the end of January.

The lecturer dealt first with the features of the gas industry which distinguished it from other chemical industries. The gas supplied to cities and smaller communities might vary widely in its composition, provided that it conformed to the uses to which it was put. In this country, in the early days, gas was supplied wholly for lighting by means of self-luminous flames; while at the present time not more than 10 per cent. was put to this use. The requirements of a public gas supply might be broadly stated to be that the gas should be that which conveyed the greatest number of heat units to the consumer at the lowest cost. The gas must also have a strong smell; it must give a flame having some, though not necessarily a high, natural luminosity; and it must not yield, on normal combustion, products which would be harmful to human beings, or would damage the ordinary contents of interiors or the structural materials of rooms, plant, fittings, or other apparatus. The cost of the production of gas was naturally affected not only by the cost of raw materials but also by the value of the products obtained. The cost of the gas to the consumer was also affected by the cost of distribution and application; and this depended mainly on the number of heat units to a given volume of gas.

The scale upon which chemical operations were conducted in a gas-works might also affect the consideration of the problems with which the chemist had to deal, and experience in some other chemical industries would be of value to him. The growth and magnitude of the gas industry in this and other countries was worth noting. He had had a summary prepared of the total quantity produced for the years 1890, 1900, and 1912; and it was clearly shown that in all cases there had been an enormous increase in the output in each period, which increase was in advance of the growth of population during the same time. It might be estimated that the world's production of town gas in the year 1912 would be approximately 620,000 million cubic feet. In the manufacture of this quantity of gas, about 60 million tons of coal would be consumed; while 30 million tons of gas coke would be sold for use off the gas-works, and about 3 million tons of tar produced, together with ammoniacal products equivalent to about 550,000 tons of sulphate of ammonia. The Beckton Gas-Works, which were at present the largest in the world, consumed about a million tons of coal per annum, and produced over 60 million cubic feet of gas per day. Possibly these works would shortly be surpassed in magnitude by some large ones in New York now in course of erection.

With regard to the consumption of gas per head of the population in the world's chief capital cities, it was to be noted that London still headed the list. In the chief cities of France, America, Holland, and Germany the quantity consumed was 6000 cubic feet, as compared with 8000 cubic feet for London. The rate of increase which had obtained in the last twenty years perhaps could hardly be expected to continue for the coming twenty years; but no doubt in 1920 in all the principal cities of the world the consumption of gas would be about 10,000 cubic feet per annum per head. The uses to which it would be put must have a prominent weight in determining the character of the gas supplied.

The lecturer then exhibited various diagrams showing the extent to which gas was consumed for different purposes, as illustrating the fact that the predominant use at the present day was for heating purposes. Probably the luminous flame burners, which would, of course, be retained on account of their convenience in some respects, did not account for more than 10 per cent. of the total output of gas.

The character of the gas supplied at the present day might be described as follows: First, it should have a gross calorific power of 540 to 580 B.Th.U., or 135 to 145 calories per cubic foot; secondly, it should have a specific gravity lying between ·4 and ·5; and, thirdly, one volume of gas should require 1·0 to 1·1 volume of oxygen for complete combustion. These characteristics might be modified in one direction or another, according to the nature and cost of the raw materials available; but the fluctuations in respect of each of these characteristics should be restricted within narrow limits as far as the gas supply to any one district was concerned. Whatever character of gas was supplied, it was eminently desirable that uniformity should be maintained from hour to hour and day to day; otherwise the consumer was worried by the necessity of having to readjust burners and so forth. Broadly speaking, in a gas supply the fluctuation should not exceed 5 per cent. in calorific power, 5 per cent. in specific gravity, and in the proportion of oxygen required for the combustion of the gas 2 per cent. He had so far indicated the general character of the gas which fulfilled present-day requirements as a guide to the chemist who was not very familiar with the gas industry, but who might be considering a new process of gas manufacture or the modification of existing processes.

The lecturer next referred to the early history of the gas industry, and gave an account of the work of Accum, who was the practical chemist on the Board of the Gaslight and Coke Company when the Company, which had the honour of being the first gas company in the world, was founded in 1812. Several pictures were shown on the screen illustrating the methods of carbonizing adopted in 1815, and those in use at the present day. Gas-making processes might be said to be divided broadly into carbonizing or coal-gas processes and water-gas processes. In 1910, carburetted water gas formed 11·8 per cent. of the total quantity of gas supplied from the gas-works of the United Kingdom; the remainder being coal gas. He referred to the fact that Accum's connection with the gas industry of this country was cut short by a regrettable incident. He was librarian to the Royal Institution, and was charged with the theft of books and dismissed. The charge failed, however, in the Law Courts; but Accum left the country in chagrin, going to Berlin, where he was for a good many years a Professor at the Technical Institute. The lecturer could not help thinking that someone had blundered in making such a charge against a man of his position and attainments.

The lecturer then went on to describe, by means of illustrations and diagrams, the various carbonizing methods, especially in regard to the chemical aspects of modern processes of carbonizing in fully-charged horizontal retorts and in intermittent and continuous vertical retorts. Specimens of coke produced in horizontal and vertical retorts derived from the carbonization of the same kind of coal were exhibited. The retorts illustrated were the horizontal and Dessau (intermittent), the horizontal and Glover-West (continuous) vertical, and the horizontal, and Woodall-Duckham (continuous) vertical. Views were thrown on the screen illustrating the differences between the settings of these types of vertical retorts and also the charging machinery used for horizontal retorts.

The lecturer next referred to the work of Samuel Clegg, who, he said, some time before the year 1819, devised a form of retort and mode of carbonizing which gave results with regard to the gas made which had scarcely been surpassed even at the present day. With the retort devised by Clegg, Accum obtained an average yield of 12,450 cubic feet of gas per ton of Newcastle coal. The carbonization of coal was now carried out in gas-works in plant which might be classed as follows: (1) Retorts set horizontally, inclined, or vertically, and discharged and recharged at intervals of four to twelve hours, the coal capacity ranging from 3 to 15 cwt.; (2) large chambers or ovens discharged at intervals of eighteen to thirty hours, the coal capacity ranging from 2½ to about 8 tons; (3) retorts set vertically and having a continuous feed of coal and a continuous extraction of coke. The modern practice was in the direction of filling the retort, which was made readily possible by means of charging machines. One of the advantages of the continuous vertical retort was that the coke was discharged cool, and was not brought into contact with water.

DOMESTIC HEATING.

At the Royal Society of Arts, on Monday evening last week, Mr. Charles R. Darling, F.I.C., delivered the last of his three Cantor Lectures on "Methods of Economizing Heat"—the branch of the subject treated of on this occasion being "Domestic Heating."

Advantages of the Open Coal-Fire.

In the first portion of his lecture, Mr. Darling dealt with the coal-fire, and remarked that there were several good reasons why it still held its own. In the first place, the radiations from hot coal were more agreeable than those from other sources; and this was due to two causes. The temperature was higher than that of a gas-stove—varying from about 700° to 800° C. in the colder parts to over 1000° C. in the hottest. This was more than one obtained from a gas-stove. Generally speaking, it was more pleasant to have these radiations from a very hot source than from a colder one. The second reason was that coal and coke, and bodies of this description, were better radiators of heat than heated fire-brick. Coal and coke were nearly perfect radiators, and one got a result that was not obtained from a gas-stove—and certainly not from electric appliances, in which the rays were filtered by passing through glass or quartz.

Another advantage of coal-fires was that in a room with an open fireplace there was very efficient ventilation. This ventilation was not effected to nearly the same extent by the gas-stove or the closed form of coal-fires. There was, with the open coal-fire, a large quantity of air being dragged up the chimney; and this resulted in a ventilating effect which was not produced by any other type of heater. Then there was the comparative cheapness. Even allowing for the superior efficiency of gas-fires from the point of view of the quantity of heat which entered the room from the fire, coal came out a great deal cheaper.

A Comparison of Costs.

He said he had prepared the following table dealing with the matter of cost—though in drawing attention to it, he admitted that it might perhaps be open to criticism.

Referring to the table, the lecturer said the figures might be taken as applying to London. With the better forms of coal-fire, one might get 40 per cent., or even 50 per cent., of the heat actually utilized in heating the room, instead of the 20 per cent.

Heating of Rooms and Buildings.

Method.	Source of Heat.	B.Th.U. Produced for 1d.	Percentage Utilized.	Relative Cost.
Open fireplace . . .	Coal at 26s. per ton	110,000	20	1
Anthracite closed stove	Anthracite at 36s. per ton	75,000	75	0·39
Hot-water radiator . .	Coal at 22s. per ton	110,000	75	0·27
Open gas fireplace . .	Gas at 2s. 6d. per 1000 cubic feet	19,000	75	1·54
Electric radiator. . .	Electricity at 1d. per unit	3,400	100	6·50

he had given. For a well-designed anthracite stove, probably the figure indicated in the table was not very far from the mark. It was shown that with well-constructed gas-fires, such as were made nowadays, the relative cost was higher than for an open coal fireplace, in spite of the difference between 75 per cent. and 20 per cent. of heat entering the room. Then there was the electric radiator. Of course, the table only showed them the actual quantities of heat that entered the room; it did not tell them many other things that would have to be taken into account when considering which was the best form of heating apparatus to use for a particular purpose.

Drawbacks to Coal-Fires.

Mr. Darling next proceeded to point out one of the chief defects of coal-fireplaces of the ordinary form as made at the present day, afterwards showing on the screen some modern types which, he said, "indicated a return to Count Rumford's scientific principles." The introduction of gas-fires, he continued, had been an unmixed blessing in many ways, and one way in which it had been a benefit was by waking up the makers of coal-fireplaces, and compelling them to put something better on the market so as to meet the competition. Dirt was, of course, one of the great drawbacks to open fires; and then there was the trouble of lighting. Whether these defects outweighed the advantage from a ventilating point of view, must be considered. Not far away, he had seen an instance of coal-fires being lighted by placing bunsen burners underneath, and letting them burn until the fire was well alight; but whether this would be economical for household life, he could not say. Another disadvantage of the coal-fire was the smoke, about which they had heard so much. It was, however, incorrect to say there would be no more fogs if soot were abolished. There would still be fogs, but they would not be so dense or disagreeable.

Smokeless Fuel.

There were one or two ways of getting rid of this smoke. Several fuels had lately been introduced to burn smokelessly; and of these, "Tarless Fuel" and "Coalite" were two examples. Of necessity, they were at present somewhat dearer than ordinary coal; but in time to come, this might not be the case. Probably the valuable bye-products obtained in the process of preparing the fuel might ultimately enable it to be supplied as cheaply as coal; but it would need works on a very large scale indeed to meet the demands of the whole community. However, extensions in this direction, he thought, might safely be looked for. Then, the anthracite stove was now becoming very popular.

Points about Gas-Fires.

After remarking that, when one came to the heating of buildings on a large scale, it was economical to use hot-water radiators, and showing some slides of apparatus for this purpose, Mr. Darling remarked that time would not permit him to say much about gas and electric heating. Another thing was that he was literally between two fires; because a short time ago Professor Fleming gave a course of lectures in which electricity was very fully dealt with, and in the future Mr. F. W. Goodenough was going to deliver two lectures on gas heating. Therefore, he would only say a few words from the point of view of comparison with coal-fires.

The advantages of the gas-fire were its ease of control and its cleanliness; but against this there was the smaller ventilating effect. The amount of air drawn from the room up the chimney was not nearly so great with a gas-fire as with a coal-fire. Again, some people objected to the noise which accompanied the use of a gas-fire—the hum of the bunsen burner. This, however, was not a great objection. Then there were the less cheerful radiations because the temperature was lower. The temperature in the hottest part was 940° C.; and the average that he himself had got was about 750°. On the other hand, in the hottest part of a coal-fire one obtained, as he said, considerably over 1000° C.; and this made a great deal of difference in the quantity of heat directly coming into the room. Further, one did not get full and complete radiations, because the gas-flames impinged on fire-brick, and the surface of fire-brick was not nearly so good for the purpose as coal and coke. That was to say, one got only selective radiation; and the rays were not so pleasing to look at or so agreeable to the feelings.

A Hotter Flame.—The Méker Burner.

There might, continued the lecturer, be improvements brought about that would overcome the difficulties to which he had called attention. One possible development was the introduction of a flame which would be hotter than that given by the ordinary bunsen burner. Taking a burner of the latter type, they would find that in the centre at the bottom of the flame it was quite cool; and the highest temperature they would get in any part of the flame was 1570°, which, as he proceeded to show by experiment, was not sufficient to melt platinum. In the Méker burner, a flame was secured which had no cool part in it. There was a nickel grid, which prevented the flame from striking-back; and in this way it was possible to get the mixture of gas and air which was requisite to attain the desired end. The flame could not strike-back through the grid, because the grid kept the gas below it cooler than the point of ignition. Passing a piece of platinum through the flame of a Méker burner, he showed that the flame was not only hot in every part, but that it was possible to melt the platinum in it.

Subsequently, Mr. Darling placed the ordinary bunsen burner and the Méker burner under two pieces of the fire-clay which, as he said, are commonly used for gas-stoves, and he pointed to the fact that the one over the Méker burner was very much more effectively heated than the other. "If, therefore," he added "you could apply the Méker burner to the gas-fire, that would get over the difficulty of the increased temperature we require to get nearer the coal-fire. It has been tried, but results so far have not been successful. It could be done; but it would make the stoves rather expensive. Another thing would be, instead of using fire-clay, to get something of a black nature which would retain the characteristics of fire-clay. These things might come to pass in the future, and, if so, the gas-fire would become an even more formidable competitor of the coal-fire than at present."

Some Words on Boiling-Rings.

Turning to another part of his subject, Mr. Darling remarked that gas-stoves for cooking were very well constructed now, especially in the oven part; but frequently the burners on the top were made wrongly. They were often in the form of rings, with no central flame. When one was heating-up a vessel, it was always best to heat it from the centre; if there was a ring of flame near the sides of the vessel, obviously much heat would escape. It was curious to see so many stoves with these rings, which did not by any means give the best effect.

A Suggestion for a Gas-Kettle.

There was one little matter he would like to point out which perhaps was not generally known—namely, that the shape of the kettle used on gas-burners in every-day life was entirely wrong. The usual pattern of kettle—the cylindrical form—was not satisfactory; and as a matter of fact it would be better to have one of conical shape. When the cylinder was on the gas-burner, the flames rose, beat on the bottom, and were so deflected that the heat mostly missed the kettle. The correct thing would be to have a kettle with bulging sides, and the bottom made as small as possible consistent with the kettle being ensured against toppling over. Then the flame, after beating against the bottom, would run up the sides and stick to them, instead of being deflected away. The result of actual experience, he declared, was to show that the bulging kettle would save 15 per cent. of the amount of gas used to bring water to the boiling-point.

Electric Heaters.

The subject of electric heaters, the lecturer was compelled to dismiss in a few words. He admitted that such appliances had their uses in places. Where no chimneys were available, they were better than anything else because they gave off no fumes, and no air was used up by them. They were also useful when it was wished to warm one part of a room, and not the whole.

"Taking all things into consideration," he said in conclusion, "the subject of domestic heating is now receiving more attention than it has done for some considerable time. It is one that should appeal to everyone, because nobody likes to see waste; and there is hope that in the future we shall have in our dwellings properly-designed fireplaces and cooking arrangements of every description."

Another View of the Electric Radiator.

At the conclusion of the lecture, a hearty vote of thanks was passed to the lecturer. In proposing this, Sir Henry Trueman Wood said the lectures had been very interesting. Mr. Darling had referred to the electric radiator, and this made him feel that he could not help mentioning one particular example with which he happened to be familiar. The appliance was fitted up in a club with which he was connected; and the only possible way in which one could get any heat out of it was by sitting upon it. "But," said Sir Henry, amid laughter, "unfortunately, it was singularly ill-adapted for supporting the human form." No doubt, he added, there were electric radiators that were not of this kind.

A cañon crossing, 455 feet below the hydraulic grade of the Los Angeles aqueduct, has to be made. The formation in this section is massive granite, and the scheme adopted for running the conduit across the gorge, as described in the last annual report of the Chief Engineer (Mr. William Mulholland) consisted in driving inclined shafts in the massive granite formation at either side of the cañon and then running out horizontally to a level with the bed. These tunnels on either side will be connected by means of a steel pipe which will be carried into the rock formation where the rock cover is 100 feet thick over the tunnel. The steel pipe is 890 feet long and the inclined tunnels are 2788 feet long and 11 feet in diameter. The tunnels and inclined shafts have been excavated and will be lined with concrete.

CARBONIZATION TESTS IN GAS-WORKS.

Recommendations by a Committee of the American Gas Institute.

The Committee of the American Gas Institute, consisting of Mr. Warren S. Blauvelt (Chairman) and Messrs. W. E. Hartman, R. B. Brown, and W. A. Miller, who were appointed to consider the subject of the carbonization of coal and the methods of conducting and reporting tests, submitted their report at the last annual meeting of the Institute; and it was briefly referred to in an account of the proceedings which appeared in the "JOURNAL" for the 5th ult. The Committee said that in the limited time at the disposal of the members it had been impossible to formulate complete rules covering the conduct of carbonization tests. They had therefore limited their report to a brief discussion of the purposes of these tests and the value of publishing the results in such form that they might be readily understood and compared, a statement of the items which should be included in the reports of tests, and suggestions as to the form in which certain of the results should be given. The Committee then remark.

The term "efficiency," as applied to the manufacture of coal gas, may be used with reference solely to technical results. Practically, however, this is of less importance to the gas industry than commercial efficiency. The latter is measured by the net profit on the investment resulting from the operation of the plant under the existing local conditions. Obviously, it is impossible to formulate any methods of making tests, the results from which would determine the commercial efficiency either of apparatus or coal for all local conditions.

Disregarding the very important factors of efficiency of management and labour, the commercial efficiency of carbonizing apparatus and the value of coal for gas making in any locality are dependent upon the net cost at the works of gas of the standard required. The items making up the total gross cost are: Coal carbonized; fuel consumed; labour operation and supervision; repairs (labour and materials); supplies; gas enrichment, if required; power, steam, water, and light; taxes, insurance, interest, and depreciation. The net cost is this gross cost less the net value at the works of the residuals—coke, tar, and ammonia; and the net value of residuals is their market value as commercial products, less the expense incurred in converting them into marketable products from the crude form in which they are recovered from the carbonizing apparatus.

The regular operation of any gas-works may be considered as being a series of complete monthly or yearly carbonization tests, if accurate records are kept of all details of operating conditions and of the results obtained, both technical and commercial. It is only from records of this sort, covering a term of several years, that the cost of repairs and depreciation can be determined. In the ordinary use of the term, however, a carbonization test covers a comparatively short period, and many items of great commercial importance are necessarily omitted.

Carbonization tests may be made to determine the best methods of operation, the value of any special kind of coal for gas making, or the efficiency of any particular type of carbonizing apparatus. Tests of methods should precede tests of coal or apparatus to ensure securing the best results practicable from the coal used in the apparatus employed. Tests of this kind are made by noting the variation in the results obtained due to altering the methods of operation in various particulars, such as temperature of retorts, pressure maintained in retorts, weight of charges, kind of fuel, frequency of charging, control of draught, secondary air, &c. Tests of methods involve not only careful attention to the particular detail which is intentionally varied, but also close observation of all other conditions which may in any way affect the results obtained. Otherwise some condition intended to be constant may vary, and thus lead to wrong conclusions as to the result of the intended variation.

The value of the report of a test of any special kind of coal is, of course, greatly enhanced if it can be compared with reports of tests of other varieties of coal made in the same plant. Similarly, reports of tests of types of apparatus are more valuable if the same kind of coal is used in the various tests. In order that these reports, whether of coal or apparatus, should be readily comparable, and hence of the greatest value for the advancement of the art of carbonization, it is necessary that the methods of carrying on the tests and the form in which the results are reported should be standardized as far as is practicable.

The report of a complete carbonization test should include the following items: (1) Statement of the purpose of the test. (2) Description of the carbonizing apparatus used and of the methods of operation. (3) Full information regarding the coal carbonized. (4) Record of operating conditions during test. (5) Quality and quantity of fuel consumed. (6) Quality and quantity of gas made. (7) Quality and quantity of the residuals obtained. (8) Operating labour required. (9) Power consumed in operating the plant.

Unwarranted inferences have frequently been drawn from published reports of carbonization tests, because these failed to state clearly the purposes of such tests. With the same kind of coal carbonized in the same retorts, very different results may be obtained, depending upon the purpose of the operator. Hence the importance of reporting explicitly the purpose of the tests, and, as completely as practicable, the conditions of operation, and the quality and quantity of all products obtained.

When a published detailed description of apparatus employed in any carbonization test is available, reference to such publication may be made instead of inserting the description in the report of the test. Information regarding the coal carbonized should include the following items: Location of the mine from which the coal was obtained; description of the treatment of the coal, if any, preparatory to charging; size of coal charged; percentage of moisture in coal charged; proximate analysis of dry coal—*i.e.*, percentage of volatile matter, fixed carbon, and ash; and ultimate analysis of dry coal—*i.e.*, percentage of carbon, hydrogen, oxygen, nitrogen, sulphur, and ash.

To facilitate comparison of the results of the tests, it is desirable that standard units should be employed in reports of all tests. As such standard units, the following are suggested: The base unit to which results of the test are referred shall be one ton (2000 lbs.) of dry coal of the kind used in the test; solid fuel shall be reported in pounds, dry; gas, in cubic feet at 60° Fahr. and 30 inches barometric pressure; tar, in United States standard gallons (231 cubic inches) of tar, containing no water, at 60° Fahr.; ammonia, in equivalent pounds of ammonium sulphate; coke, in pounds, dry, and be understood to include all coke passing over a screen having ½-inch square openings; and breeze, in pounds of dry breeze, and include all screenings from the coke as above. Operating labour shall be reported in hours, and comprise all labour required to work the carbonizing plant, including charging and discharging retorts or ovens, care of stand-pipes, hydraulic main, handling fuel and ashes, and quenching coke. The power consumed shall be reported in horse-power-hours, and shall include all power consumed in operating any mechanical appliances used in working the carbonizing plant.

Your Committee realize that comparatively few plants are equipped to secure all the particulars suggested herein; and they hope that the inability to secure complete data will not tend to discourage the publication of results obtained. There is ample room for difference of opinion as to whether the recommendations made are the best possible; but all engineers who have had occasion to study the reports of tests will agree that the adoption of standard methods and standard forms of reports would be advantageous. Should the submission of this report result in the adoption by the Institute of such standards, the labour of the Committee will be amply rewarded, even though the specific recommendations contained herein be disregarded.

The Committee submitted a set of suggested forms for tabulating the results of tests.

THERMAL VALUE AND CANDLE POWER OF GAS.

Report of the American Gas Institute Committee.

In the account of the proceedings at the annual meeting of the American Gas Institute which appeared in the "JOURNAL" for the 5th ult. (p. 426), it was mentioned that the report of the Committee appointed to consider the subject of the thermal value and candle power of gas was presented by the Chairman (Mr. W. H. Gartley). The Committee was nominated early in 1910, the other members being Dr. A. C. Humphreys, Dr. A. H. Elliott, Mr. R. M. Searle, Mr. J. B. Klump, and Mr. J. F. Wing; and their instructions were to consider: (1) The benefit to be derived by the adoption of a thermal value standard to the consumer and to the operating company. (2) What limitations would be found to be involved in the operation of a gas plant in maintaining a constant thermal value to the gas. (3) The stability of a gas made to a thermal standard as compared to a gas made to a candle-power standard. (4) The effect of atmospheric conditions in the measurement of the thermal value of a gas. The Committee reported as follows.

Report of the Empire State Joint Committee.—Almost coincidently with the appointment of this Committee (Feb. 1, 1910), a conference was held in Albany, New York, at which there were invited to appear before the Public Service Commission for the Second District of New York representatives of the gas companies in the State, gas engineers, and experts from elsewhere, including representatives appointed by the President of the American Gas Institute, and representatives of the United States Government from Washington, to discuss the relative values of illuminating and heating standards for the gas supplied in the Second District. At the meeting a Joint Committee, under whose immediate charge and direction (subject to the approval of the Commission) the inquiry should be concluded, was formed from the Empire State Gas Association and representatives appointed by the Commission—these representatives being the Commission's engineers—to make a careful investigation on the necessity for a calorimetric standard, and finally report to the Commission, who would then endeavour to have such changes made in the legislation of the State regarding gas inspections as would conform to their knowledge as influenced by the findings of the Committee.

The Committee have had frequent meetings. They have kept themselves informed regarding the best modern thought on the subject, and have instituted in some fifteen gas companies in the State daily parallel readings of candle power and heating values, extending over at least one whole year—using the most approved instruments and methods known to modern practice, and taking cognizance of the various details of gas operation that would have any bearing upon the subject.

It needs no argument to show that such a report, involving

perhaps a radical change in gas-works operation throughout the largest State in the country, based on data obtained from trained observers in fifteen gas plants and on the programme arranged by the Commission, would be conducted on a more comprehensive plan and at greater expense than could be hoped to be undertaken by a Committee of the American Gas Institute. Your Committee, therefore, believe that they can serve the Institute no better than to refer them to the report of the Empire State Committee, which will be made public within the next year.

Bureau of Standards Discussion of Heating Values.—During the last year, the question of rating by which the calorific values of gases shall be compared one with another has been reopened, principally through an address delivered by Dr. E. B. Rosa, of the Bureau of Standards, at the Franklin Institute in Philadelphia during the celebration of the centenary of gas lighting.* Dr. Rosa has made a clear and concise statement which appears to have been somewhat misinterpreted by some members of the Institute. Dr. Rosa has enumerated three classifications of the calorific value of gases:

1.—The "total heating value," which is the total heating effect that is produced by the combustion of the gas. This heating effect can be "measured by the calorimeter per unit quantity of gas burned if the air (admitted to the calorimeter at room temperature) is dry, and if the water vapour formed by combustion is all condensed in the calorimeter, and both it and the products of combustion escape at room temperature. In other words, when gas is burnt in dry air at room temperature, and the total products of combustion are cooled to room temperature, and all water vapour formed is condensed to water, the total heat given up in the process is called the total heat."

2.—The "gross heating value," which is the value determined by the calorimeter, and to which Dr. Rosa objects, because such determination is influenced by extraneous conditions not inherent in the quality of the gas itself, such as temperature and quantity of water vapour in the incoming air and outgoing products of combustion, and the quantity of air used in the combustion.

3.—The "net heating value," which Dr. Rosa defines as the "gross heating value *minus* the heat of condensation at room temperature of the water deposited in the calorimeter and collected outside per unit of gas burnt." Also, the net heating value is the total heating value (as defined above) "*minus* the latent heat of all the water vapour produced by combustion."

Both the total heat and the net heat, he states, are independent of the amount of water vapour entering the calorimeter with the incoming air current or of the quantity of water vapour leaving with the products of combustion. That is to say, they are independent of the quantity and temperature of the air entering the calorimeter and of the atmospheric humidity, and depend only on the quality of the gas burnt.

Dr. Rosa argues, therefore, that since the gross heating value does not depend solely on the quality of the gas burnt, and the total heating value cannot be determined by the ordinary flow calorimeter, and the net heating value does depend solely on the quality of the gas burnt, and can be determined accurately by the flow calorimeter, in comparing the calorific value of one gas against that of another it should be by means of their net heating values.

Your Committee believe that the members of the Institute will not widely disagree with Dr. Rosa in his premises or mathematical deductions, but, for practical reasons resulting from years of experience, will be reluctant to accept the net heating value as a standard of the quality of gaseous fuel, for the reasons: (1) That gaseous fuels should be classified according to their total heating value; and (2) that there is and can be no fixed relation between the total heating value and the net heating value of gaseous fuels. Two gases may have equal total heating values and unequal net heating values, just as two gases may have unequal total heating values and equal net heating values. To illustrate: Hydrogen has a total heating value of 326·2 B.Th.U. per cubic foot, and carbon monoxide 323·5 B.Th.U. Hydrogen burns entirely to water; and since, by Dr. Rosa's statement, $H = T - B$, in which B is the latent heat contained in the mass of water vapour formed by the combustion of the unit quantity of gas, it follows that the net heating value of hydrogen, which burns entirely to water, must be B less than that of carbon monoxide that produces no water from combustion, and hence has its total heating value equal its net heating value.

Your Committee believe the Institute will prefer to retain its definition of the heating value of gas as adopted by the Institute at its annual meeting in 1908, as set forth in the "Proceedings" for that year:

> The heating value of a gas is the total heating effect produced by the complete combustion of a unit volume of the gas, measured at a temperature of 60° Fahr. and a pressure of 30 inches of mercury, with air of the same temperature and pressure; the products of combustion also being brought to this temperature. In America, the unit of volume is the cubic foot; and we recommend that the heating value be stated in terms of British thermal units per cubic foot of gas.

How far the variance between the total heating value and the gross heating value as determined by the modern flow calorimeter, approved by the Institute's Committee on Calorimetry, and when operated under the rules and observing the precautions set down by the Committee, will extend, can be determined by a perusal of the reports of that Committee; but we earnestly recommend to our Committee on Calorimetry, the Bureau of Standards at Washington, and others, the necessity of devising a calorimeter that will permit of the total heating value of a gas being determined to a close approximation to accuracy, by observations on an instrument that can be used under the same general conditions that now obtain with the use of the present flow calorimeter, if it be found that such determinations cannot be made on the present approved type of calorimeters.

Your Committee recommend to the officers of the Institute for the ensuing year that a Committee be appointed to confer with the Bureau of Standards on this subject of classification of qualities of gas through their heating values. We recognize the great desirability of being in agreement with the Bureau of Standards on this important subject before the issuing of further bulletins by them, and have taken the liberty of adding as an appendix to this report the argument of Dr. Rosa in his Franklin Institute lecture on the measurement of the heating value of a gas.

Required Heating Values.—Your Committee desire to call attention to the belief prevalent in America, if we are to judge by the standards already adopted by State Commissions and municipalities, as to the permitted heating values of gaseous fuel, that it is wise to adopt a heating value excluding all but the highest grades of manufactured gas as well as natural gas. This is opposed to the modern view of the necessity for the conservation of energy—the uneconomical and wasteful method of excluding the large volume of gas capable of being manufactured which falls just short of these higher standards.

We desire to call the attention of the Institute to the fact that this belief in the necessity of the highest standards is not shared by the authorities abroad who fix the standards for the larger gas companies. In London, at least one company is now required to substitute for the illuminating power standard a calorific standard of 540 B.Th.U. gross, with liability to penalty only on a lapse to below 475 B.Th.U. gross. In Paris, a net heating value of 522 B.Th.U. is required; and the Budget Committee in 1911 recommended that candle-power requirements should be abolished. In Berlin, the Corporation undertaking—a municipal plant—is observing recommendations of German chemists that the gas supplied should have a gross calorific power equal to 543 B.Th.U., and not to fall below 522 B.Th.U. per cubic foot. In Buenos Ayres, Argentina, a recent new franchise granted to the Company requires a net heating value of 539·4 B.Th.U.

Appended to the report is an extract from the address of Dr. Rosa to which the Committee referred.

* See "JOURNAL," Vol. CXVIII, p. 643.

Doherty's Gas-Producing Methods.

Patents have lately been taken out for the United States by Mr. Henry L. Doherty, of New York, for improved gas-producing plant; and abstracts of the specifications have appeared in the "Journal of the Society of Chemical Industry" for the 16th inst. In a method of operating gas-producers, a vertical conveyor is arranged in a flue at the back of the producer, and operates continuously to withdraw partially burnt fuel from the lower part of the column, and deliver it, in admixture with fresh fuel, to the top. The partially burnt fuel passes to the conveyor through an inclined perforated shoot, so that the ashes fall through the perforations into an ash-pit, and are not fed again into the producer with the fuel. According to another patent, the producer contains a deep bed of fuel, and is worked with an up-draught of steam and air; the steam being generated and the blast heated in a recuperator by the sensible heat of the gases leaving the producer. The gas outlet is at about the middle of the height of the fuel column. The upper part of this column, consisting of freshly charged fuel, is carbonized by the flames from a number of burners arranged in the upper part of the producer walls. Each burner has a passage for the gas, surrounded by a passage for air; and regulating valves are provided in both passages.

Testing Welded Joints.

At the last congress of the International Association for Testing Materials, M. Frémont, of Paris, presented a paper in which he advocated the impact test for determining the strength of welded joints. According to an abstract of the paper given in a recent number of the "Builder," the author employed, for the purposes of his experiments, test-pieces measuring 8 mm. by 10 mm. in cross section; the welds having been made in France and elsewhere by smiths specially selected on account of their skill. The welds were of the scarf-jointed type, so as to obtain large contact surfaces. The iron adopted for the various welds had a tensile strength of from 35 to 40 kilos. per square millimetre; and the mild steel a tensile strength of about 40 kilos. per square millimetre. Impact tests on the unnicked test prisms gave from 26 to 32 kilos. for the iron and about 50 kilos. for the steel; the test-pieces not exhibiting fissures in any instance. Among the better results obtained, the steel-on-steel test-pieces exhibited a fair amount of deformation before failure; the force required being from 15 to 16 kilos., or less than one-third the strength of the original metal. From the results obtained by the author, it appears that the static strength of the forged scarf-jointed welds is equal to the static strength of the metal only when the welded surface is sufficiently large to compensate for the lower strength per unit area. Autogenous welds are weaker than forged welds.

IMPORTANCE OF GAS COMMERCIALISM.

In the course of his Inaugural Address at the Eighth Annual Meeting of the American Commercial Gas Association, held at Atlanta (Ga.) early this month, and noticed in another part of the "JOURNAL," the PRESIDENT (Mr. C. L. Holman, of St. Louis) made the following remarks on the value of commercialism.

One of the important questions of policy having a direct bearing upon the entire gas business is that referring to national advertising as proposed to be conducted under the auspices of the Association. Here, I think, the need of company membership in the body is accentuated. In dealing with this subject, it seemed really more a matter for decision by the companies than by the individual members in convention. Probably no other subject was given more careful and thorough study, considered from more differing angles, than this one of national advertising. At the very outset, there were a number of companies, large and small, some wielding an unusually large influence in the gas field, who felt strongly that such a plan as that proposed should be put into immediate action. There were other companies, and officers and owners of companies, who were strongly of the idea that the plan as proposed was not sufficiently matured to permit of proceeding with it. Your Board of Directors did not, after careful study of six months, find a favourable solution of the question. Finally, at the suggestion of your President, the Board considered it the part of wisdom that more consideration should be given to the subject before presenting it generally to the companies for support.

Lest I should be misunderstood, I wish at this time to voice my opinion as to the great value of advertising through the many different channels offered. Unquestionably, the trade journals cover an important field; and general magazine advertising holds great merit. But to sell our product, we must appeal to the classes and the masses, to the rich and the poor, to the foreign and the native-born. To accomplish this end, we should not overlook that local institution whose success so largely comes from the same home market as that in which the gas company operates—a friend and ally, working in all seasons for the upbuilding of our respective cities and their honestly conducted businesses, that medium which offers such direct and tremendous advertising probabilities for the gas company—the local Press of our country.

Until a comparatively recent period, practically all the thought and effort of those in charge of gas companies had been devoted to the engineering end of the business, or that having to do with the manufacture, distribution, and the general efficiencies to be obtained from the mechanical side of the business. Technical schools and colleges became interested in the training of men desiring to embark in gas engineering business, with the result that, through the assistance of gas company officials, we have a trained and skilled staff of operators and assistants for this particular branch of the work. During all this time, the commercial, or selling, end of the business received but little attention. With the constantly changing industrial conditions due to aggressive competition, the commercial branch of the industry has become a most vital part of the gas organization. The demand for a trained force of salesmen and demonstrators could not be met. To supply this demand, the National Commercial Gas Association several years ago took up the work of conducting independently an educational course for commercial men. More determined effort should be put forth by the Association, and more active support should come from the companies in the further developing of this facility for instruction to those who find the commercial side of the gas business alluring, and who want to make themselves proficient in it. There certainly is just as crying a need for development and training of the commercial man as of the technical man. After we have the proper quality and quantity of product to dispense, the financial success of the business then largely depends upon the result-producing activities of the commercial department. Without the highest class of ability and great efficiency in that department, the progress of the business must, of necessity, be limited. The salesman cannot expect to sell the gas company's product unless he knows fully its uses. He must be imbued with the idea that he is offering a needed commodity and is really performing a service when he influences a customer to purchase.

How is this general information to come to the salesman unless through like advantages which have been offered to the engineer? There is a great dearth of statistics and information absolutely essential to the best success of the commercial side of the business. The need of practical, definite data on the part of the commercial man is keenly felt; and I recommend that the Board of Directors should appoint a Special Committee, whose sole duty it shall be to compile statistics having to do with the performance of recognized gas appliances, and their effect upon the general business. It has been stated by engineers, as well as by commercial men, that data which would show the proper effect of consumption of different appliances on instantaneous, hourly, daily, or monthly peak loads, as well as the effect on the manufacturing and the distribution systems, the proper ratio of various peak loads to annual sales, &c., would be of telling importance. The work of such a Committee would be invaluable to the building-up of selling arguments for the industrial engineering salesman, whose field now seems to be so promising. It would also prove of incalculable advantage in determining the desirability of offering special rates (if allowable) for large or off-peak business.

We all recognize the importance of the manufacturing and mechanical end of the business, and how valuable the men in these departments are; but there has not been sufficient interest manifested, or funds given by gas companies, in providing ways or means for the training and developing of the keen gas commercialism which is warranted and needed. Every company should, in my opinion, have some of its employees enrolled in this educational course—should support it morally and financially—and give the general subject of salesmanship instruction the very serious consideration and help which it deserves. This broad question of educating salesmen is certainly one of great practical importance. It has to do intimately with policies of companies and with all the activities employed in building-up a gas business through the disposition of its product. Here again is forcibly brought to our attention the great need of closer affiliation of the commercial department and the engineering and technical departments of a company.

While not overlooking the great importance of pushing our business through small appliances, a question of greater consequence to the commercial man is to sell his product in large quantities. More thought and action should be given the big prospects—"industrial," "heating power," and "big lighting"—instead of confining most of our sales' efforts to those units which call for the maximum expenditure of energy with a minimum consumption of gas. Special effort should be exerted by all gas companies to develop big demands for gas, which, due to some peculiar condition, location, or environment, or to the cost of other fuels, warrant a working chance for accomplishing some big results, and pursue them with a determination to bring them into the gas field. The tendency of the times seems to swing towards bigger fields and the selling of gas more in wholesale quantities, and at prices calculated to cover special uses and demands. Are we following too closely the well-blazed pathways? Are we too content to accept what has been handed down as tradition in gas marketing? Do we lean too much on others' successes, achieved after diligent study and much expense in experimentation, or are we doing our full part? Surely, all the possibilities of gas have not as yet been developed. With the assistance which should be given by the manufacturer in the improvement of his appliances, backed up by thoughtful and persistent experimenting with present-day conditions, and well-directed study of the demands and desires of the user, new avenues for the usefulness of gas are bound to present themselves. To accomplish results along such lines, it will probably be necessary for companies, large and small, to conduct experiments in their own territories in an endeavour to develop such new fields. If your study finds foundation in some promising theory for the development of a possible new line, talk about it, dream about it, and constantly work at it until you have demonstrated either its practicability or its impracticability. Seek out the weak spots and faults in your own systems and operation. Study the conditions surrounding your particular locality. Assiduously endeavour to sell gas in large quantities, at small profits, if necessary; and the vastness of the possibilities of gas will cause the commercial man to be proud of his connection with this great business. Assert the fact yourself, and impress it upon your associates, your present and prospective customers, that you are connected with the biggest, livest business in the world. Loudly herald your good gas offerings, and work towards bringing about a new commercialism, to rank ahead of that employed by any other utility service. You have the best and cheapest commodity, adaptable to practically every use for which heat, light, and power are and will be demanded. Gas is no mediocre business; but, on the other hand, it will not develop itself beyond certain limits. We should rely upon our own efforts to discover new openings and originate new fields for its use, and not wait for what we think our competitors may overlook.

Here again is emphasized the urgent need of high-class industrial engineering salesmen—men sufficiently trained to positively guarantee to customers results of the use of gas. This talk about selling gas in large quantities is not new. Everyone talks more or less about gas for industrial purposes, and many companies to-day are endeavouring to locate men trained thoroughly along practical industrial gas lines. The field is broad; but the men to cover the field, to cover it intelligently and effectively, are most difficult to find. A special course of instruction in the use of gas for industrial purposes and for other large uses would result in more actual good to the respective companies and the industry as a whole than any other one commercial effort which could be put forth. I recommend that the subject be given the closest attention, and that definite and speedy steps be taken to provide ways and means for the thorough training of men to supply this much-felt need.

The Co-Partnership Almanac for next year which accompanies the current number of the "Co-Partnership Journal" of the South Metropolitan Gas Company, bears, as usual, a message from the Directors to the co-partners. It is appropriately placed in a central position on the sheet, under a portrait of the late Sir George Livesey, beneath which is the motto: "Co-Partnership is Brotherhood in Business." The message runs as follows: "The shares in the business held by South Metropolitan Co-Partners are worth to-day £369,971; but their loyalty and goodwill are beyond price. The Directors are glad of the opportunity to acknowledge this and to wish their employees, and those near and dear to them, a Happy New Year." The list of co-partnership gas companies has been increased this year to 36, by the addition of the Aldershot, Hertford, and Liverpool Companies.

WATER POLLUTION AND PURIFICATION.

Papers Read at the Institution of Water Engineers.

As stated in the report of the proceedings at the winter meeting of the Institution of Water Engineers which appeared in the "JOURNAL" last week, two of the papers submitted dealt with the subjects of water purification and water pollution. We give below some extracts from them, with a report of the remarks to which they gave rise.

RECENT ADVANCES IN THE SCIENCE OF WATER PURIFICATION.

By ADOLPH KEMNA, D.Sc.

Underground waters have been preferred from very ancient times, not only because of the abundance of water obtained in many cases, but also because such supplies are usually characterized by constant temperature and natural purity. It is a fact that many underground waters are excellent, and yield plentiful supplies to populous cities; but it is an obvious exaggeration to consider this the only permissible source of public water supply. All underground waters are not abundant, nor are they always chemically pure, nor hygienically innocuous. There are many examples of springs which have become very dangerous by contamination and which have spread epidemics of typhoid fever. In France, for several decades the purity of springs was considered as unquestionable; the engineer agreeing with the theoretical hygienist in this opinion. The frequent recurrence of typhoid epidemics in Paris was, however, finally traced to the contamination of first one and then another of the springs from which supplies were obtained; and similar experience was obtained in many other places. A comparison between the health statistics of spring-supplied and surface-supplied towns resulted in favour of the latter, and naturally brought about a change of opinion as to the superiority of underground waters which were no longer considered as the only admissible sources of supply. This change took place between the years 1895 and 1905. At about the same time, there was also a change of opinion in Germany, but in the reverse direction.

Surface water supplies have the great advantage that the quantity can be correctly estimated. There would be only one way to deal with an engineer who made a gross mistake in gauging a river or in calculating the yield of a gathering-ground. There is also another safeguard in connection with surface-water supplies—viz., that being always open to contamination, they must be treated as if contaminated, and purification is absolutely essential.

In a previous paper, the author has given a historical sketch of sand filtration, and has shown how Simpson's first attempt in 1829 proved efficient for the mere clarification which at that time was all that was required, and which later proved equally efficient to meet the increasingly severe demands of the hygienist. But here a qualification is necessary, and we must say the "reasonable" hygienist.

The rooted conviction as to the hygienic efficiency of all sand filtration, although fully justified, has had one drawback—viz., the absence of any inducement to improvement. For a period of some fifty years the sand filter remained practically unaltered; the only addition to it which has become general was a preliminary treatment by the simple process of decantation. The theorist can certainly claim that he roused the engineer out of this state of torpor. Koch took up the question of filtration from the special standpoint of the bacteriologist, and introduced certain rules for the management of filtering stations. Koch was of a peculiarly practical turn of mind. By profession a medical man, he contended that all scientific studies in this department should only be considered as the means to an end, and especially with a view to practical application. His rules for the conduct of filtration works were the outcome of direct connection with actual practice. He wanted to improve the results, and was fully aware that asking too much was the way to get nothing. Therefore he was moderate in his requirements, and even in suggesting a limit of 100 microbes per cubic centimetre he admitted the possibility of varying the standard to meet exceptional cases.

Moderation does not seem to be within everybody's power, and "common sense" is not at all common! This explains how the microbe craze started. The medical profession no doubt has its normal share of unbalanced minds, and among these will be found those who have most conspicuously run amok on microbes. Their proportion is numerically small, but their voices are strong; and by taking an extreme view, they have obtained the prominence they desire, and have found ready followers. Among these, the heartiest supporters are the inventors of patent filters or sterilizers. Absolute sterility—that is, complete absence of microbes—is, no doubt, "a consummation devoutly to be wished," and many people have devised systems by which this can be assured. Through the medium of the patent agent, various forms of filters, applications of ozone in nearly endless variety, quartz lamps for ultra-violet rays, and a full set of chemicals to "drug" the water, have been, after due protection was secured for the inventive genius in each case, showered on the engineering world for the immediate benefit of mankind. A multiplicity of systems is a necessary condition of competition and that struggle for existence which ultimately results in the "survival of the fittest." But, in the meantime, the existence side by side of so many competitors is a proof that none of them has attained to that degree of efficiency which would ensure its survival and the disappearance of its rivals.

Those who are conversant with biology know how important a matter is the geographical distribution of plants and animals in deciding questions of affinities and parentage, and in disclosing the otherwise unrecorded history of our earth. It has also a certain analogous bearing on the subject of this paper. Take, for example, the application of ozone to the sterilization of water. The first laboratory experiments were made in Germany; the first application on a somewhat larger, but still experimental scale, was made in Holland; the Belgian Government adopted the system to purify the water at Blankenberghe, a seaside resort near Ostend; but it was specially in France that the system was readily taken up, and that the technical and hygienic authorities made the most of it. Nice on the Mediterranean is at work on it; Paris is fitting up the system at St. Maur filtering station, which the Institution visited in 1908 when comparative experiments with various systems were going on. In Germany there are a few installations; and in Russia the utterly bad system of filtration in use in St. Petersburg has been supplemented by an ozone plant. The English-speaking countries, however, which include more than half the civilized world, seem to be very reluctant to adopt ozone purification; and there appears little likelihood of their changing their attitude.

Ozone is, no doubt, a very powerful chemical agent; and for this very reason it is the more strange that since its discovery in the forties by Schönbein it has not been turned to practical use. There are obviously objections to its use, and among these the following may be mentioned: Its production by electrifying air is rather difficult and costly; it cannot be obtained pure; and only a small percentage of the air treated can be made into ozone, so that comparatively large volumes of air have to be dealt with. The greatest objection to it seems to be its insolubility. Passing a gas through water is nothing in the laboratory; but on a large scale it is more difficult. Even with an extremely soluble gas, such as ammonia, we find the scrubber the most conspicuous apparatus in gas-works. It is, of course, unfortunate that the use of ozone involves such difficulties, for it readily destroys colour as well as microbes, and itself turns into ordinary oxygen, so that nothing of it remains in the water. Experience has shown, however, that even with ozone complete sterilization is practically impossible; and at the same time a certain selective action has become apparent—some microbes being more easily destroyed than others. The more resistant are the ordinary harmless water bacteria; while the pathogenic bacteria are the more sensitive. Now, the detection of the latter in a water is a mere matter of chance, and of very remote chance. For several years past, the scientific staff of the Metropolitan Water Board have been making a systematic hunt for the typhoid bacillus in the Thames water. Certainly more than a million microbes have come under notice, but not a single "*typhosus*" could be detected. The ozone people at St. Petersburg felt so sure of being able to destroy the *bacillus coli* that they accepted a clause by which a fine of 1000 roubles was incurred for each detection, with the result that in June last they had to pay 26,000 roubles. Under such circumstances, the harmless *coli* might prove to be a valuable asset to the exchequer of a municipality!

Ozone is not the only compound which can evolve single atoms of oxygen in the nascent state. A variety of chemicals do the same, with the same sterilizing effect. Permanganate of potash has been used at Alexandria (Egypt); the gaseous oxygenated compounds of chlorine, and lately ordinary bleach (chloride of lime), have also been employed. Strange to say, the chemical nature of the last-named substance is not exactly known. There are various structural formulæ, not one of them fully accounting for all the facts; but there is no doubt as to its hygienic efficiency. It has been effectively demonstrated by the fact of its having stopped epidemics of typhoid. In one case, exactly ten days after starting the application of chloride, an epidemic was suddenly arrested, and the diagram showing the number of new cases fell abruptly to zero. The three consulting engineers who had been called in, and who immediately and unanimously ordered the use of chloride of lime, certainly expected a favourable result, but not such a striking one as that. Another most important result of this experiment is the exact determination of the period of incubation—still a vexed question with medical men—the mean period being shown to be exactly ten days.

The application of chloride of lime is simplicity itself. A solution of the required quantities is made and regularly run into the water; and the plant can be started in a few hours. In some parts of America, portable plants have been provided, which are let out to municipalities when required. Within a period of five years, the use of this system has spread all over the States, and its efficiency is no longer questioned. No trouble has been experienced from taste. Three parts per million of chloride of lime represent only one part, or one milligramme per litre, of chlorine—a quantity which falls within the limits of error of ordinary chemical analyses. The taste (if any) only exists just after the introduction of the reagent, and rapidly disappears. Since the year 1904, the author has used chloride of lime in various ways at the various stages of the process of filtration—*i.e.*, before decantation and before filtration, and before and after storage in the clean-water reservoirs. Since December, 1910, chloride has been used regularly and constantly at the Luythaegen auxiliary pumping-station of the Antwerp Water-Works, where the water

is pumped to the town, with the view of still further reducing the number of microbes.

There is not the slightest doubt that the chloride of lime process constitutes the greatest advance which has been made in water purification during recent years. The proofs of its hygienic efficiency are overwhelming. It acts like ozone, without the necessity of complicated machinery; and it is soluble, and readily diffused through the bulk of the water, so that intimate contact is ensured without cumbrous mechanical appliances. As it would be difficult to patent such elementary apparatus as casks and tubs, the chloride of lime process is free from the attentions of the inventor, and can be arranged to suit any special local requirements. Indeed, its simplicity is in some respects a drawback, as the author knows of one case where ozone was adopted partly because the municipality wanted to be able to boast that their water was purified "electrically."

Another "drug" of the water engineer is sulphate of alumina, the systematic use of which was introduced with the "mechanical" or "rapid" filter. This also comes from America. It operates by a reaction between the sulphate of alumina and the carbonate of lime present in the water; sulphate of lime being formed. Carbonate of alumina ought also to be formed; but as such a combination does not exist, the alumina is precipitated in large sticky flakes which form round the particles of suspended matter and carry them to the bottom. With most waters, mere decantation after the addition of the sulphate of alumina is efficient in from 12 to 24 hours. Anything not deposited then is very difficult to get rid of. The author has used sulphate of alumina regularly for several years past, rather for decolorizing than for purposes of decantation.

The use of alumina enables the water engineer to overcome the difficulty of a highly coloured water, which, though quite innocuous from the hygienic point of view, is very objectionable to the consumer. The treatment of water with sulphate of alumina is cheap and easily applied, and is not open to any reasonable objection whatever. The precipitated alumina is retained by the filters; nothing passes into the effluent. The sulphate of lime remains in solution, and is perfectly harmless; on the contrary, the casual addition of some lime to very soft waters can only be beneficial. It is, however, important to ensure a uniform distribution of the reagent through the whole mass of the water. Where there is a constant flow at the intake, a solution of the required strength may be constantly added in regular quantity; but where the river is tidal, and subject to considerable variation in the amount of pollution at the different stages of the tide, the intake period may have to be limited. Under such circumstances it is found that even if the whole quantity of sulphate is added at the same time, the inrush of the water secures its being thoroughly mixed and well distributed.

There are many other systems of purification, some of which have already been experimented with, and others which may ultimately prove to be of value. The solar spectrum shows a gradation of undulations, with various physiological effects. The red end is chiefly heat, the middle portion is light, and the violet end is mainly chemical—this latter action extending beyond the limits of visibility, and constituting the ultra-violet rays. Direct experiments long ago proved that these rays are bactericidal; and the effect of prolonged storage upon microbes is certainly due to a great extent to this action. It is therefore quite reasonable to apply these rays for the purpose of sterilization. Some lights contain a great abundance of ultra-violet rays, especially that from the mercury lamp; but, ordinary glass being impervious to these rays, the lamps used for sterilization must be constructed of quartz, which is transparent to the rays, but is expensive. To secure effective action, the water must be quite clear, which means, in the case of any ordinary surface water, very complete preliminary filtration, as even a slight tinge of yellow absorbs these rays. A water which, though clear, has the slightest colour, must also be first decolorized. It will therefore be seen that, in the case of surface waters, the ultra-violet rays do not replace ordinary filtration, nor, in some cases, the use of sulphate of alumina, but must be considered as a supplementary treatment of a precautionary nature, exactly as in the case of sterilization with chloride of lime.

Dr. Houston, in one of his reports, has suggested the use of lime as a sterilizing agent. This substance has been used for many years to soften hard waters; the dose being calculated according to the amount of dissolved bicarbonate to be precipitated, and being itself neutralized in the process. To sterilize, much more lime must be added; and after having exerted the sterilizing action, this excess can be neutralized by mixing it with a certain volume of untreated water. There would also be a reduction of hardness, which would be beneficial to water such as that derived from the Thames. At first sight, there seems to be an inconsistency in sterilizing a part of the water and then mixing it with unsterilized water; but Dr. Houston only considers the application of the process to cases of emergency, when but a part of the supply would require the special treatment.

Speaking broadly, it may be said that all these systems apply only to surface water; but this is due to the fact that generally spring waters are naturally pure and do not require any treatment. A few only of the various systems are intended to replace the time-honoured sand filtration, but most are intended to be supplementary to it. The contention is that sand filtration alone is not absolutely reliable, and that therefore something more must be done. But it is with the same purpose in view that many water engineers have undertaken the closer supervision of filters, frequent chemical and bacterial analyses of the water, and the erection of laboratories, &c. It must be borne in mind that the reduction or elimination of bacteria is not the only or chief object in view, but rather the maintenance of health and the prevention of cases of water-borne diseases. The author has stated what has been done at short notice by the use of chloride of lime; but it must not be assumed that the distribution of untreated river water should be considered as a normal proceeding. He firmly believes that, with ordinary and reasonable care, sand filtration is a sufficient safeguard against the distribution of polluted water; and such was the view of Dr. Koch when he formulated his conclusions on the immunity of Altona from cholera in 1892. Supplementary treatment and scientific control are improvements on older methods; and there is a moral obligation upon the water engineer to do his best in the interests of his consumers. But the intelligent adoption of improved methods and new processes does not necessarily involve the disparagement of older methods which have stood the test of time.

POLLUTION OF PUBLIC WATER SUPPLIES.

By John C. Thresh, D.Sc., M.D.

The author introduced his subject by stating that during the past year he had met with an unusual number of cases in which water authorities had required assistance to elucidate the causes of contamination of their water supplies. In some cases, advice had been sought on account of the complaints of consumers of the water; in others, on account of analysts having detected the *bacillus coli* in the water supply, and consequently giving more or less unfavourable reports. Such complaints and reports were not invariably substantiated; and in the cases mentioned in the paper the allegations were not always well founded. Dr. Thresh then cited the following cases.

I.—*Pollution of Deep Well Water.*

The water from a deep well in the new red sandstone began to show signs of contamination; the *bacillus coli* being found in about 10 c.c. of the water, whereas previously it had not been found in much larger quantities. The directors were certain that no contamination could arise at the works; and the author, contrary to his usual custom, commenced by examining the neighbourhood around the outcrop of the sandstone, but found nothing which in his opinion could affect the well. On inspecting the works, however, he found that the water was first raised to an iron tank, of 2000 or 3000 gallons capacity, under the engine-house floor, and was then forced to the service reservoirs some distance away. The water in this tank was covered with dust and appeared greasy, and the sides were decidedly slimy; and the author naturally concluded that this was the most likely source of contamination. The engines were stopped, and the tank being emptied, the sides and bottom were found to be in a very offensive condition. This slime was afterwards examined bacteriologically; and had its source not been known, one would have concluded that it had been taken from a tank at some sewage works. It was a mass of bacteria of objectionable type and contained myriads of *bacillus coli*. The tank was thoroughly cleaned and properly covered in, and the water at once regained its pristine purity.

II.—*Contamination of a Spring Supply.*

This spring water supplied a population of about 5000. The periodical analyses made by the county analyst showed that it was of excellent quality until early this year, when a sample was found to contain the *bacillus coli*. Another sample was taken and the result confirmed. As another source was available, the spring supply was cut off, and the author was asked to investigate. The corporation owned only a few yards of land around the spring, so that there was really no protective area; but the water came from a bed of sand under a layer of boulder clay, and this boulder clay apparently sufficed to prevent pollution, though there were many houses near and above the spring. There had been no known change in the drainage of these houses to account for the pollution of the water, which, moreover, was always beautifully bright, and even when containing the bacillus the chemical quality had remained unchanged. The spring and its immediate surroundings were then examined. The spring arises at the bottom of a large reservoir having a semicircular galvanized iron roof. The water boils up in three different places; but a little oozing was found near a side wall, where the sand was mixed with a little clay, and appeared to be discoloured. Samples were taken from these different points, and were all found to be of the greatest purity except that from the point near the side wall. This sample was grossly polluted, and contained the *bacillus coli* in abundance. Round the outside of the reservoir or collecting-tank the earth was soft, especially near the spot where the polluted water entered; and a sample was found on examination to be contaminated with manurial matter.

Inquiry elicited the fact that during a long spell of dry weather the roof of the reservoir had become almost covered with bird droppings from the surrounding trees, and that the water was first found to be contaminated two or three days after a heavy rainfall, which, as the roof had no gutters or spouting, had washed all the filth from the roof on to the ground. At the point where this was soft, near the source of pollution, the author made a hole with a walking-stick, poured in a little strong solution of fluorescin, and then added two or three pails of water. Within an hour the

fluorescin was visible in the reservoir—the coloured water entering at the point of discoloration. There was no doubt, therefore, that the filth from the roof had gained access to the reservoir, and given rise to the bacillus found in the water. The soft earth around the reservoir was removed, and a broad concrete channel constructed. The discoloured sandy clay at the bottom of the reservoir was also removed, and a load or two of clean sand substituted for it. The reservoir was then allowed to fill again; and the water being found to be quite free from any signs of contamination, its use for the purposes of a public supply was resumed.

III.—*Contamination of Another Spring Supply.*

In another county a spring water went wrong exactly as in the preceding case; but here the spring was in the centre of a huge meadow, in a depression, with a wire fence round the reservoir, which was covered. The fence was only a few yards from the spring, and near the fence at the top of the slope were quantities of cow dung. Apparently the cows were attracted to this spot by the shelter afforded by a few trees. With every rainfall some of the manure must have been washed down the slope; and as the difference between the level of the water in the reservoir and of the ground outside was only a few inches, there was no doubt that the *bacillus coli* was washed through the soil and entered the spring. The author recommended the construction of a concrete channel round the reservoir, and the pushing back of the fencing so as to keep the cattle a greater distance away. When this was done, the water would no doubt be perfectly satisfactory.

IV.—*Worms in a Public Water Supply.*

During last summer, a water authority began to receive complaints about "worms" appearing in the water at the house taps, and their meter examiner reported the finding of worms in the water-meters. Specimens were submitted to the author, and proved to be the larvæ of a fly. Flushing the mains not having ridded the district of the pest, the author was asked to investigate the matter. The water entering the reservoir was found to be free from worms, and there were none in the water leaving the reservoir. He, however, ascertained that on certain lengths of main there were no complaints, and that on one long main all the complaints came from consumers living beyond a certain point. Samples were drawn from taps throughout the area; and they confirmed these statements, and the author came to the conclusion that the larvæ or the ova were gaining access to the mains at the ball hydrants. These were said to be well looked after and to be kept clean; but the first one visited, situated just below where the complaints commenced, showed that they were anything but clean. This and others contained quantities of road scrapings and washings. The author, of course, recommended the cleansing of all the boxes and the thorough flushing of all the infected mains; and after this had been done the "worms" disappeared. The author would strongly urge the necessity for a new Statute, or a clause in the Public Health Acts, forbidding the use of these old-fashioned ball hydrants, which are a constant source of danger to water-supplies.

V.—*Alleged Pollution of a Subsoil Supply.*

A sample of water taken from a house tap was submitted to an analyst and condemned by him, causing great alarm and excitement. After examining the works and taking samples of water for examination, the author was satisfied that no source of supply could be less liable to pollution; and he found that the samples of water examined were of excellent quality. Subsequent inquiry indicated that a portion of the mains had not been efficiently flushed, and that the sample of water condemned was taken from this piece of main. To condemn a whole water supply and thus create a panic merely because of such an incident as this, is, in the author's opinion, entirely unjustifiable; but it is not at all an uncommon occurrence. Not long ago, such a sample, taken from the mains of an important water company, was submitted to the author, who, after inquiries, found that the inspector had gone to a fire hydrant, turned on the tap gently, and filled the bottle with the water as it escaped. Another sample was taken from the same spot after opening the valve and allowing the water which had stagnated in the pipe to escape, and this was of unexceptional quality. Sufficient care is not taken, as a rule, in collecting samples for analysis. The following experience is a further confirmation of this statement.

VI.—*Alleged Pollution of a Town Supply.*

A case of typhoid fever having occurred in a large house connected with the public supply, the owner sent a sample of water for analysis. It proved to contain far too many bacteria, including the *bacillus coli*. The owner was informed of the results of the examination, but was warned that it would be unsafe for him to accuse the sanitary authority of supplying a contaminated water unless he could prove (1) that the water came direct from the main, and (2) that the sample had been properly taken. On visiting the house, the author found that the pipe from which the sample had been taken terminated at a tap over the kitchen sink, and was undoubtedly a branch direct from the main. The tap was a large one, and on inserting the little finger into the nozzle it brought away a slimy mass of filth, resembling dirty boiled sago. This proved to consist almost entirely of bacteria, and the water taken after the tap had been cleaned and flamed was perfectly satisfactory in character.

VII.—*Intermittent Pollution of a Town Supply.*

The water supplied to this town was very variable in character—sometimes excellent, at others showing undoubted signs of contamination, notwithstanding that it was sand filtered. On examining the works, the author found the whole supply drained from a brook, the water from which was passed through small sand filters and then pumped to a reservoir supplying the town. The houses near the brook were kept under supervision, but upon tracing up the stream, it was found to run across a road where it was forded by every vehicle which passed. It also drained meadows in which cows were pastured; and there was no difficulty in finding places in which the cows stood in the water and defæcated and micturated as Nature demanded. To obtain another source of supply was impracticable; and the directors, on learning the facts, were ready to acknowledge that some system of purification was absolutely necessary. Having speedily made up their minds, a chlorination system was adopted; the sand-filtered water being passed through a De Chlor apparatus. The arrangement has been installed for more than six months, and the water is examined twice and sometimes three times a month, and invariably with satisfactory results; and whereas previously the water often contained hundreds of bacteria per cubic centimetre and the *bacillus coli* in 1 to 5 c.c., it now contains on an average about 4 bacteria per c.c., and no *bacillus coli* has ever been found in 100 c.c.

VIII.—*Intermittent Pollution of Another Town Supply.*

This town derives from a river water which, after sand filtration, is supplied to the consumers. On occasions the water had been unsatisfactory, and when an outbreak of typhoid fever of some magnitude occurred in a small town about ten miles above, which discharged all its sewage in an absolutely crude state into the river, the condition became so alarming that the Local Government Board called upon the water authority to take immediate steps to improve the condition of the supply. The author was able so to improve the filtering arrangements that within a period of two days the authority were supplying a perfectly safe water. One of the small sand filters was emptied of its contents and made into a chlorinating chamber, and an adjoining tank was filled with layers of sand and charcoal. A smaller tank was used for making the solution of chlorine, and a man superintended the flow—dosing the filtered water with 1 part of chlorine per million. The treated water takes about half-an-hour to traverse the chlorinating tank, and then passes through the sand and charcoal filters direct into the mains. The water has been absolutely free from the *bacillus coli* since the chlorination commenced, and the town has not had a single case of typhoid fever. Why, in the Twentieth Century, a town should be permitted to cast its raw sewage into a river which a few miles below supplies many thousands of people with water, passes the author's comprehension. The fact that it is possible is a disgrace to our boasted civilization.

IX.—*Contamination of a Large Public Supply from Deep Wells.*

The water from this supply acquired a peculiar and very faint odour which was especially observable when a large quantity was drawn to fill a bath; and complaints began to be received. The water was examined, and, comparing it with waters from similar wells in the locality, it was found that it differed from them in containing more free ammonia and sulphates and in absorbing more iodine. Upon going down the well to investigate, a smell of coal gas was noted; and as there were gas-works about 100 yards away, some connection between them and the well was suggested. A sample of water obtained from a large gasholder was found to contain not only a quantity of free ammonia but also millions of bacteria per cubic centimetre—one proving to be the same as one isolated from the well water. There was no doubt about the connection, and the gasholder was thrown out of use. On the tank being examined, it was found to leak badly. After the use of the gasholder had been abandoned, the ammonia gradually disappeared from the well water, the sulphates decreased, and the water became practically normal.

X.—*Alleged Pollution of a Water Supply from Hastings Sands.*

Quite recently the author was called upon to examine a public water supply on account of the *bacillus coli* being found in the water taken from the mains. The inhabitants of the district had been advised to boil the water before using it, although the local officials declared that they could not see how the water could become polluted. The well is shallow, and situated in the centre of a level area of uncultivated land, of which about 12 acres are fenced off for protective purposes. There is only about one house in this area besides that occupied by the water-works engine driver, where the closet is provided with a pan, and all excremental matter is mixed with combustible material and burnt in the furnace. The soil around is very light sand, and it was noted that rabbits abounded and burrowed near the well. Pollution from any dangerous source is impossible; and the author, having concluded that the occasional *bacillus coli* comes from the excrement of these small animals, has advised that steps should be taken to keep them at a respectful distance.

XI.—*Pollution of a Spring Supply.*

In this case, the water supplies a population of about 5000, and is derived from a spring in superficial gravel. The surroundings are unfavourable; there being quite a large population on the gravel above the spring. Notwithstanding this, the water is always absolutely bright and of excellent quality chemically. It is also most satisfactory bacteriologically, save after heavy rainfall. Within 24 hours of such rainfall the *bacillus coli* could be

found in the water; but in a very short time the water regained its purity. The source of the contamination took many months to discover. Fluorescin tests made at a number of trial holes above the spring all gave negative results; and holes made near the spring showed that the water came from below a bed of clay intercalated in the bed of gravel, and that this bed thinned out and disappeared at one side of the reservoir. When the reservoir was emptied, practically the whole of the water was found to come from this side; and when fluorescin was put into a trial hole in the adjoining field on the side from which the water flowed, the water was not affected until the lip of the bed of clay was pierced. When the fluorescin got into the gravel below the clay, the water entering the reservoir was coloured within 24 hours, and remained so for two or three days. Fortunately, there was a supplementary supply to the district, otherwise it would have been impossible to make such a free and effective use of colouring matter. Control of the field was obtained, and a careful watch has since been kept upon the water. Heavy rainfalls still increase the number of bacteria; but the *bacillus coli* no longer appears. A spring in such a position is not an ideal source from which to obtain a public supply; and such sources require very careful watching and guarding if they must continue to be used.

The author expressed the hope that the notes presented might not only prove of interest, but also be useful. He said the mere analysis of a water was without interest unless the results could be correctly interpreted; and by studying examples of the kind he had given, experience was gained which enabled one to interpret other results more or less correctly.

The concluding portion of the paper was devoted to the subjects of testing the electrical conductivity of water as a gauge of purity, and of the use of "Permutit" for softening purposes.

On the first-named subject, the author pointed out that most of the cases of contamination he had noted were discovered by the results of one analysis differing from those of previous analyses—thus showing that some change had occurred in the water. He stated that in some instances it was possible to obtain indications of such a change without resorting to either a chemical or a bacteriological examination, and at the conclusion of the meeting the author showed the members present a method of determining the electrical conductivity of a water. The process was especially delicate with certain waters of low conductivity; a very slight change in character affecting the reading on the index of the machine when a current of electricity was being passed through the water.

Referring to "Permutit," Dr. Thresh said he would also exhibit a sample of it, and demonstrate its remarkable property of softening water by merely passing a hard water through it. This action was Nature's way of softening water; the Thanet sand under London and the adjacent counties possessing the same properties. The chalk water from Hertfordshire, for example, which is very hard, filters through the sand, and where pumped up in London is found to have become very soft, and to contain carbonate of soda instead of carbonate of lime. The author stated that this system of softening was being installed by a large water company, and that he recently had to investigate the medical aspect of the question, and give an opinion as to the effect of such a softened water upon health. Sooner or later, therefore, this subject would become of interest to water-works engineers, as, from a large number of softening experiments with various kinds of sands, granites, &c., it had been found that the zeolitic minerals appeared to be widely diffused in Nature.

DISCUSSION.

Mr. W. T. Burgess (London) remarked that the cases of pollution to which Dr. Thresh had referred were very interesting; and, of course, every chemist and bacteriologist who had had any experience with water was familiar with similar cases. He would like to emphasize the point made by Dr. Thresh in dealing with a case where sewage was turned into a river utilized for water-supply purposes. The author said that in these days the fact that this was possible was "a disgrace to our boasted civilization." He (Mr. Burgess) would like in this connection to call attention to the fact that the Sewage Commission, in its recently issued report, contemplated the possibility of the discharge as relatively small to the volume of water, of 1 part of sewage to 500; the sewage being discharged in crude state, or after simple straining. In his opinion, the report ought to be in the hands of every water engineer, because he did not feel at all happy about the recommendations of the Commission. The point that Dr. Thresh had mentioned about Thanet sand and the change of hard water to soft water containing carbonate of soda was quite an interesting one. He remembered a meeting at which Dr. Thresh dealt with the possibility of using Thanet sand for water-softening purposes; and his reply to a question on that occasion was that the Thanet sand was only capable of softening a few times its own volume of water. In trying some experiments, he (Mr. Burgess) had found that a sample of the sand was capable of softening over 27 times its volume of water. This did not come up to "Permutit," the bulk of which would perfectly soften at one run more than a hundred times its volume of Thames water.

Mr. A. B. E. Blackburn (Sunderland and South Shields Water Company) thought the papers showed them that bacteriology had its limits. There were bacteriologists who dogmatized as the result merely of their bacteriological examinations. He thought the authors of the papers had shown that this was a bad thing. The medical profession realized this, because at a meeting of the British Medical Association in Liverpool in July this year, there was an important resolution passed, after three splendid papers by Dr. Houston, Dr. Savage, and Dr. Wright, which resolution should be quoted. It expressed the unanimous view that no opinion as to the quality of water for dietetic purposes should be arrived at on bacteriological evidence without a topographical inspection of the local circumstances was made by an unbiassed and competent observer. With regard to the softening by "Permutit," he would like to know how the costs worked out. He understood that the material had to be regenerated with common salt, which was more expensive than lime. In one particular case, the cost was one-and-a-half times that of softening by lime.

Mr. Walter Hunter (London) also thought that the question of cost was an important one. He recollected some ten or twelve years ago, Sir William Crookes and Sir James Dewar recommended the London Water Companies to do something in this way; but they found the cost absolutely prohibitive.

Mr. James Dewhirst (Chelmsford) remarked that it seemed to him that the lesson of the papers was that it was essential that an engineer in charge of underground supplies should be as equally on the alert as an engineer who took a supply from a river. The papers showed in their respective ways the importance of every water-works engineer looking after his sources of supply continually, and following up any indication that his water was either intermittently or permanently polluted. With regard to one of the cases quoted by Dr. Thresh, he (Mr. Dewhirst) considered that the putting of an intermediate tank under an engine house floor was bad practice; and he also considered that ball hydrants should be dispensed with. He spoke of the difficulties experienced in tracing the sources of intermittent pollution; and he urged the importance of continuous experiments until the exact travel was ascertained. When this had been done, it might be said by some that the supply ought to be abandoned, but in small districts, or districts in which they could not get much water, this was not always possible. It was of the utmost importance that engineers in charge of comparatively small works should devote a considerable amount of time to the elimination of every possible source of pollution; and if at any time it was found that there was any change in the water, the matter ought to be taken in hand before it went too far. Water-works were commenced in an area only partially populated; but the fact that the water-works were there caused the district to grow, and building operations to be carried out on what was practically the gathering-ground. Thus it came about that the very existence of the works might contribute to the conditions that might cause pollution. It was not in such cases possible to abandon the works.

Mr. H. C. Adams (London) said the cases cited by Dr. Thresh served to emphasize the facility with which water might become polluted. They also showed what a simple matter the pollution was; but unfortunately the simplicity was not apparent until the cause was found, and much time had to be expended in finding the cause. He pointed to the importance of periodically testing the sanitary appliances at and near the water-works, as, however perfect these appliances might be initially, they were subject to deterioration. He endorsed the condemnation of ball hydrants, but instanced a case in which he was carrying out extensions where all the hydrants were of the ball pattern. He was faced with the fact that the fire appliances in the district fitted the ball hydrants; and much as he should have liked to have had nothing to do with them, he was forced to perpetuate them in the town. As to softening by "Permutit," he was glad Dr. Thresh had spoken so emphatically regarding the safety of the water for human consumption. There was, however, another side to the question, and that was as to the suitability for trade purposes of water so treated. They must all admit that the health of the individual was paramount; but the material welfare of the community was a very close second. If the treated water was unsuitable for trade purposes, and if the manufacturer had to treat it subsequently at some expense, the probability was that it would drive trade out of the district. Recently his firm were considering the question of advising on the softening of a water supply. They considered the merits and demerits of all types of softeners, and particularly in relation to "Permutit." In this country, it was at present to a great extent an untried process; and the engineer advising its adoption incurred considerable responsibility. They made every possible investigation into the use of the process abroad, collected facts and figures, analyzed them, and considered the matter from the chemical point of view. Eventually, they thought the balance was in favour of "Permutit;" and they recommended the adoption of the system. The scheme would, in due course, come before the Local Government Board; and they were naturally interested in knowing what action the Board would take. He believed the question of expense depended to a large extent upon the hardness of the water, and as to the relative proportion of temporary to permanent hardness. The lime process was cheap, and much cheaper than "Permutit." In the latter process, the carbonate of lime was converted into carbonate of soda, instead of being deposited as mud as in the lime process. In regard to trade use, the allegation (which was strongly supported) was that in boilers the water with carbonate of soda in it caused very serious corrosion. They could not, however, find that the carbonate of soda was the cause of the corrosion.

Mr. L. C. Walker (Reading) said that he was very interested in

Dr. Kemna's statement that "there is not the slightest doubt that the chloride of lime process constituted the greatest advance which has been made in water purification during recent years." The reason for his interest was the fact that he had adopted the chloride of lime process in the Candy "De Chlor" filter. He had had twelve years' experience with it; and the bacteriologist had not been able to find the *bacillus coli* in 100 c.c. So satisfied were they with the chloride of lime process, that they had recently installed a plant capable of dealing with a million gallons of water per day. Respecting Dr. Thresh's reference to ball hydrants, no one could agree with them. At Reading he had a large number; and he was gradually displacing them with screw-down hydrants; and he found that having the two types of hydrants was in no wise a detriment. Screw-down hydrants could be obtained with bayonet joints; and the joint to fit the ball hydrant could be made to fit the screw-down hydrant.

Mr. H. C. HEAD (Winchester) said he was interested in the case in Dr. Thresh's paper in which allusion was made to contamination from a leaky gasholder tank. He had read of this with some considerable surprise, as he remembered that some years ago a series of examinations was made of waste-water drainage from gas-works, and it was singularly free from bacteria. It occurred to him that, in the case mentioned in the paper, it was possible (he did not know whether Dr. Thresh had made inquiry into this point) that the large number of *bacillus coli* found in the gasholder tank water was due to the efforts to stop the leakage. Where there was a small leakage in a gasholder tank, it was common practice to put oatmeal into the water, so that it might be drawn into the cracks. Oatmeal was now universally used; but where the leak was a large one, horse dung was frequently substituted. If the water was largely polluted in this way, it might account for the great number of bacteria that Dr. Thresh found. With reference to the instance in which there was pollution by rabbits, carbide of calcium was an effective way of getting rid of the rabbits; and they did not return.

Dr. THRESH: What about the effect on the water?

Professor HENRY ROBINSON (London) spoke of the advantage he had experienced by consulting chemists and bacteriologists. In his opinion, water engineers who carried on their work without reference to a chemist or a bacteriologist were guilty of a grave mistake. He instanced a case where a scheme had been designed, and he was then called in. By the assistance of an analyst, he detected a flaw in the quality of the water, and was able to trace the origin of the mischief. This led to an entire alteration of the scheme. Regarding ozone, he had used it in connection with the purification of water; and any member interested in the subject could have a copy of the report that he had made upon it.

Mr. F. W. HODSON (Loughborough) pointed out that the old chemical analysis was merely inferential, and was it not, he asked, similarly so with the *bacillus coli*—it was merely an inferential indicator? Dr. Thresh pointed out that the *bacillus coli* came from all sorts of sources. Was there any reason to dread the *bacillus coli* when it was known that it could only possibly have come from rabbits, pigeons, or the roadside?

Mr. H. PRESTON (Grantham) and Mr. F. H. BRUNT (Rochdale) also contributed to the discussion.

Mr. W. PATERSON (London) observed that Dr. Kemna, in one part of his paper, stated that ordinary filtration was an efficient safeguard against water-borne disease. He should like to know how he reconciled this with the statement made later on that "it must not be assumed that the distribution of untreated water should be considered a normal proceeding." Every mechanical filter maker with an open mind must admit that the good results got with slow sand filtration could not be obtained with rapid mechanical filtration, unless it was helped by some other system. He noticed that Dr. Kemna stated that the application of chloride of lime was simplicity itself; while a little later he referred to an instance where it had been a failure. He (the speaker) considered it absolutely essential that with this system the water should be metered, and the reagent added in weak solution. He was of opinion that any trouble experienced with the system was due to some people having used it to excess. Dr. Thresh had referred to "Permutit;" and there was a point relating to it upon which he should like to obtain his opinion. Several natural waters contained a considerable amount of free carbonic acid. He understood that it was necessary to remove this before the "Permutit" process could have any effect upon the water at all. He should like to know if this was really the case, because, if so, it rather complicated matters. He also asked whether the process had any effect on bacteria. Did it sterilize the water at all, or was it necessary to add some other sterilizing waters? Personally, he could not see how any system that had been evolved could approach Dr. Clark's process. It was old now, and was considered out-of-date. But he was convinced that, if they had been using such a system as "Permutit" over the same period, and some one now came along with Dr. Clark's system, it would be hailed as a great advance in the science of water purification.

Mr. C. H. ROBERTS (Aberdeen) was struck with Dr. Kemna's remark in the latter part of his paper, that the science of water purification should be advanced rather by improvements of existing methods than by the introduction of any new processes. The Doctor believed in slow sand filtration; and he ought to be thanked for his insistence on this. There were those who had made too much of the patented systems; and sometimes the unpatented ones were discredited without any sufficient reason being adduced.

Mr. S. C. CHAPMAN (Torquay) read some remarks by the late Mr. James Mansergh, from the proceedings of the Institution of Civil Engineers, as to the elimination of bacteria from drinking water. Mr. Mansergh said that they were accustomed to be told that it was necessary to remove all bacteria from drinking water; but as to whether or not they were right in so doing, was a question upon which he personally had some misgiving.

Mr. W. H. HUMPHREYS (York) remarked that Dr. Thresh in his interesting paper said he should like to hear the experience of engineers in discovering bacteria or any fault in the water supply, and what steps had been taken to correct it. He (Mr. Humphreys) had had an experience which might interest the members in connection with an uncovered service reservoir of 2 million gallons capacity. This service reservoir was used for supply late on Sunday night and very early on Monday morning. He believed he had told the members previously that they kept their own chemist, and made their own tests daily of the water supply to the different parts of their area. He (Mr. Humphreys) was puzzled by the number of bacteria on Monday mornings; and after considerable investigation, it was found that it was caused by bird droppings on the high-service reservoir. This showed how wonderfully keen the bacteriological test was to discover a thing like this. They put the reservoir out of use entirely, and only kept it for emergencies. Respecting blue books and reports, &c., he suggested that the Institution should, through the Council or an Investigating Committee, keep the members apprised as to anything of importance that occurred in them. One thing in Dr. Kemna's paper that struck him as being very true, though often overlooked, was the efficiency of the old sand filters. The sand filter was a thing they should not despise. Speaking as a user of both mechanical and sand filters for twelve years, he pinned his faith to the old sand filter. The mechanical filter had its uses; but if there was the slightest doubt as to the contamination of the water, he never put his trust in mechanical filters. In his case, they combined the two. One was a great friend of the other; the mechanical filter reducing the work done by the slow sand filter. But he would never think of using mechanical filters unless he had a slow sand filter as an absolute certainty and stand-by. He was rather surprised more water-works in the country did not keep their own chemists. It was a very useful, and very desirable, proceeding. The cost was not serious.

Dr. KEMNA replied at length to the discussion. Among his remarks he mentioned that if chloride of lime was used in excess, they must, of course, expect to get trouble. He also spoke of the purifying power of reservoirs. Useful purifying work was done in them; but he did not know of a single engineer who had ever constructed a reservoir solely for the purpose of purification. There were roughing filters or slow filters that were capable of showing the same purifying result in a less costly way. The question of treating large quantities of water by the Clark process was a very big one. It was certainly to be desired; but there were some things they dearly desired but could not obtain.

Dr. THRESH, referring to the "Permutit" process, remarked that the presence of carbonic acid did not matter in the least. They had gone into the question of the softening of water for boilers; and they found that nearly the whole of the allegations came from certain sources. His experiments had not confirmed these statements. So far as he knew, no one had suggested that putting water through "Permutit" affected the bacteria present. It did to a small extent, but no more.

ANCIENT AND MODERN WATER-WORKS.

At the last Annual Convention of the American Water-Works Association, Mr. EDWARD WEGMANN, a consulting engineer of New York, read the following paper on the above subject.

WATER-WORKS OF ANCIENT ROME.

From the remotest ages, works were undertaken to obtain ample supplies of water for domestic purposes. In Egypt, these works consisted in canals for irrigation and domestic supply. No ruins are found of aqueducts such as were built by the Romans. In Asia Minor, water was sometimes conveyed in earthen or stone pipe to considerable distances. Jerusalem was partly supplied with water by a line of earthen pipe, about 10 inches diameter. Remains of this old pipe-line, which was probably constructed in Solomon's time (B.C. 970), are still to be seen. The city of Laodicea, in Phrygia, was supplied with water by an aqueduct some five miles long, which was probably built about 260 B.C. The crossing of a deep valley on the line of this conduit was effected by an inverted syphon, consisting of two lines of 9-inch stone pipe.

Up to the end of the First Century of the Christian Era, the Romans had built nine aqueducts. They have been described in great detail in a book written about 97 A.D. by Sextus Julius Frontinus, who was at that time "*curator aquarum*"—caretaker of the aqueducts—or, as we would say, Commissioner of Water Supply. Frontinus appears to have been a very conscientious official. On assuming his duties, he made a careful examination of each of the nine aqueducts existing at his time, gauged the flow to the best of his knowledge, and wrote their history. His book has been translated into English, French, and German, and is read with as much interest now as when it was written. Three additional aqueducts were built for Rome after the time of Frontinus.

The Romans were very particular about selecting good sources

of supply—generally springs—for their aqueducts. As the only material they possessed for making water-pipes subjected to considerable head was lead, which was expensive, they generally located their conduits so as to avoid crossing deep valleys. For the greater part, their aqueducts were built in tunnels by the "fire-setting system," which consisted in heating the rock and then chilling it with water to crack the rock so that it could be removed by bars and wedges. The shafts were located usually about 240 feet apart. When valleys had to be crossed, arcades were built to carry the conduit at the proper level. A notable exception to this rule occurred in the aqueduct of Lyons, where two deep valleys were crossed by twelve lines of 12-inch lead syphon pipes encased in masonry. No two of the aqueducts supplying Rome had the same cross section. This was probably done to make it easy to identify each aqueduct. The oldest aqueduct, the Appia, was 2·62 feet wide and 5·23 feet high. The largest conduit was the Anio Novus, which was 3·28 feet wide and 8·86 feet high.

The early aqueducts were built entirely of dry-cut stone masonry, with the exception of a concrete lining 4 to 6 inches thick. A cement of excellent quality was used in this lining. It was made of pottery pounded into small pieces and mixed with quicklime. For the later aqueducts, rubble masonry or brickwork was used. The bottom water channel was left very rough, probably to reduce the velocity of the current to aërate the water and keep back sediment. About every half mile, an angle was made in the line of the aqueduct. Some writers have thought that this was due to difficulties in securing the right of way; but others are of the opinion that these angles were introduced to retard the velocity of the current. The grades of Roman aqueducts in different parts of Europe vary from about 1 in 3000 to 1 in 6000. In some of these conduits the grades are quite regular, while in others they vary considerably.

The aqueducts terminated in Rome in large public reservoirs, some of which received the water from several conduits. From the reservoirs the water was conveyed in lead pipes to private reservoirs. The quantity drawn out of each reservoir was gauged by the size and number of the outlet-pipes. The quantity that could be drawn to each domestic cistern was regulated by a short bent tube of bronze, which was inserted in the side wall of the reservoir, and formed the inlet to the service-pipe.

The total quantity of water delivered daily to Rome in the time of Frontinus has been greatly exaggerated by certain writers, who made calculations based upon erroneous assumptions. In some encyclopædias we read that this daily supply amounted to nearly 400,000,000 gallons. Mr. Clemens Herschel has pointed out that the nine aqueducts existing in 97 A.D. did not deliver, in all probability, more than about 84,000,000 gallons per day. At the present time, the city of Rome is supplied by four aqueducts, which deliver 100,130,000 gallons per 24 hours.

Water-Works of New York.

Among the greatest water-works of modern times are, beyond question, those of the city of New York. Prior to 1774, the inhabitants of this city obtained from public wells the water required for domestic purposes. The first of these wells was sunk in 1658. In 1774, the first public water-works were constructed for New York according to plans prepared by Christopher Colles, an English civil engineer. The water was distributed through hollow logs. In 1799, the Manhattan Company obtained a Charter for supplying the city of New York with water from wells. The supply was insufficient in quantity and bad in quality.

In 1834, however, the State Legislature authorized the city of New York to obtain a supply of "pure and wholesome water" from the Croton River. The works necessary for securing this supply were constructed from 1837 to 1842. A "fountain reservoir" was formed by building a dam 50 feet high across the Croton River, about nine miles above its mouth. From this reservoir the water was conveyed to the city in a masonry conduit 8 ft. 5 in. high and 7 ft. 5 in. wide. The Harlem River was crossed by a fine aqueduct bridge known as High Bridge, having fifteen semicircular arches. The water was received in a reservoir of 180 million gallons capacity, built on land forming now part of Central Park, and then conveyed through three lines of 36-inch mains to a distributing reservoir at Murray Hill, where it was let into the distributing mains. These works were first put into service on July 4, 1842. For nearly fifty years they supplied the city, though they were severely strained to keep up with the increased consumption. According to the original plans, the Old Croton aqueduct, as the conduit above referred to is now called, was only to deliver about 36 million gallons per day. To keep up with the consumption, this conduit was forced by 1880 to deliver about 95 million gallons daily.

From 1880 to 1884, a small additional supply of 23 million gallons per day was obtained from the Bronx and Byram Rivers. From 1884 to 1891, a second aqueduct, having a capacity of about 300 million gallons per day, was built from the Croton Valley to New York City. This conduit, known as the New Croton aqueduct, is 13 ft. 6 in. high and 13 ft. 7 in. wide. The Harlem River was crossed by a syphon tunnel about 1300 feet long, excavated about 300 feet below tide. The new aqueduct was put into service in 1890. Its construction cost about $20,000,000.

The works which have been described are those of the former city of New York which forms since 1908 the boroughs of Manhattan and The Bronx of Greater New York. Each of the boroughs of Brooklyn, Queen, and Richmond has its own water-works. The three aqueducts supplying Manhattan and The Bronx can deliver about 400 million gallons per day. In case of a severe drought, the Croton, Bronx, and Byram Rivers will not yield more, on an average, than about 300 million gallons a day. As the two boroughs mentioned consume at present more than 300 million gallons daily, it is evident some new source of supply must soon be drawn on. This fact was realized in 1900.

In 1902, a Commission of three expert engineers—Professor William H. Burr, Rudolph Herring, and John R. Freeman—was appointed to investigate all possible sources from which New York could obtain an additional supply of water. This Commission recommended that a daily supply of 250 million gallons should be obtained from the streams in Dutchess County, immediately north of the Croton watershed, and that an additional supply of 250 million gallons should be derived from streams in the Catskill Mountains. An Act passed by the Legislature prevented the City of New York from diverting any water from Dutchess County, and the city had therefore to go to the Catskill Mountains to obtain its supply. The necessary works to secure a supply of 500 million gallons per day have been in course of construction since 1905. The work when completed will consist of an aqueduct 17 feet high by 17 ft. 6 in. wide, capable of delivering daily 500 million gallons. This water is to be distributed to all the five boroughs of Greater New York.

The Catskill aqueduct, as the new conduit is called, will consist of "cut and cover" aqueduct, 55 miles; grade tunnel, 14 miles; pressure tunnel, 17 miles; steel-pipe syphon, 6 miles—total, 92 miles. The aqueduct begins at the Ashokan reservoir on Esopus Creek, which will have a storage capacity of 130,000 million gallons, and terminates at the city line, at the Hill View reservoir, which will store 900 million gallons. The Hudson River is crossed by a syphon tunnel 14 feet in diameter, which was bored through solid rock about 1100 feet below the surface of the river. To provide for emergencies, the Kensico reservoir is being constructed on the Bronx River, 30 miles north of the city. It will store 40,000 million gallons.

From the Hill View reservoir the water will be distributed through circular pressure tunnels from 11 to 15 feet in diameter, which are to be excavated deep below the streets in solid rock. From two terminal shafts in Brooklyn, steel and iron pipes will convey the water to the boroughs of Queens and Richmond. The length of this distributing system is 34 miles.

The works now in course of construction will cost about $200,000,000. The supply from Esopus Creek will only average about 250 million gallons per day. In the future, additional reservoirs will be constructed to obtain another daily supply of 250 million gallons from the creeks in the Catskill Mountains.

Dawlish Public Lighting Arrangements.

A curious decision was arrived at by the Dawlish Urban District Council at a recent special meeting, when the contract for public lighting was under consideration. It was resolved that there should be 34 lamps of 200-candle power, and the remainder of 100 candle power. The Gas Company and the Electric Lighting Company both sent in tenders; and it was moved that the lowest offer be accepted. An amendment was, however, carried, that the 200-candle power lamps should be lighted by electricity, and the others by gas. How strange this determination is was pointed out by Mr. J. A. Gray, the Manager of the Teignmouth Gas-Works, in a letter to a local paper, in the course of which he said that, acting on instructions, the Surveyor prepared a specification for the complete lighting of the town for a period of five years; and in order to insure equality of conditions, all gas-lamps were specified to be lighted and extinguished by means of automatic controllers. The tenders were submitted on a price per lamp per annum basis, for 100 or 200 candle lamps, and included the supply of the necessary lanterns and burners. The Surveyor ultimately reported that the Gas Company's tender was £22 15s. per annum less than the Electric Company's for the whole of the lighting, *plus* a further saving of £13 10s. per annum due to 30 existing lanterns, the property of the Council, being in good condition. The annual cost for gas lighting with 100-candle power lamps amounted to £404 15s. In submitting their tenders, both Companies quoted alternatively at increased cost per lamp for a share of the lighting only; the Electric Company's addition being 15s. per lamp, and the Gas Company's 3s. The effect of the Council's decision to divide the lighting is: (1) Total amount to be now paid for public lighting per annum, £495 8s. (2) Tender of Electric Company for the whole of the lighting, as per conditions now arranged, £474. (3) Gas Company's tender for the whole of the lighting, as per conditions now arranged, £462 18s. 10d. (4) Gas Company's tender for 100-candle power lamps, for the whole of the lighting, as previously stated, £404 15s. "It must," adds Mr. Gray, "be truly gratifying to the ratepayers to know that either the supply of gas or electricity, as tendered for, would have been cheaper to them than the combination of both."

The Baronet Tout.—The "Financial News" says: "Sir C. B. H. Soame, Bart., is still touting (New) Toddington gas shares. We invite the Bart. to state what dividends this concern has paid in the eight years of its existence. Has it paid any?"

Irish Municipal Authorities' Association.—A conference of delegates from Irish municipal authorities held recently at the Dublin Mansion House formed an Association of Urban Councils to deal with matters relating to municipal government, including housing, gas, water, &c. The Lord Mayor of Dublin (Councillor L. Sherlock, LL.D., was appointed President of the Association; the Lord Mayors of Belfast and Cork, Alderman Hadden (Wexford), and Mr. M. M'Donagh (Galway), Vice-Presidents; and Mr. R. Finlay Heron, the Town Clerk of Blackrock (Co. Dublin), is the Hon. Secretary.

REGISTER OF PATENTS.

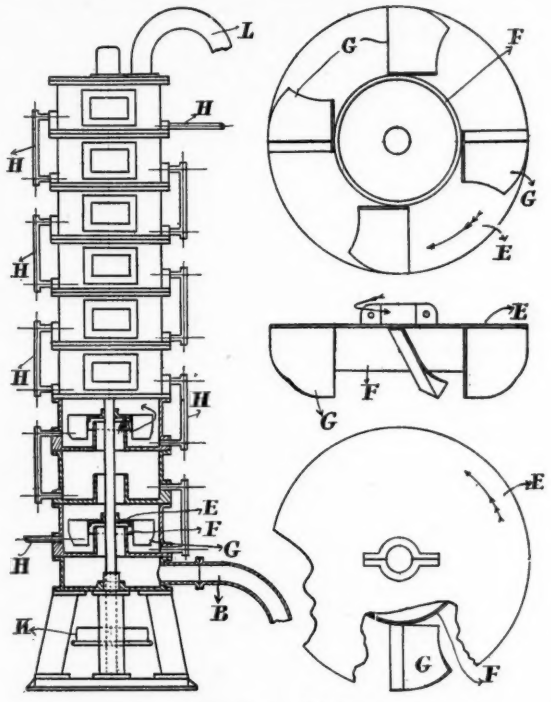
Purifying Coal Gas.

SUMNER, A. W., of Grays, Essex.

No. 27,072; Dec. 4, 1911.

This invention—particularly applicable to the purification of coal gas—relates to apparatus of the type in which "a gaseous fluid is caused to pass over an extensive surface of liquid or solution, so that one may act on the other, or one or more constituents of the one may pass into the other."

In some machines of this type, the patentee points out, the agitators are liable to become clogged by tar, naphthalene, &c. To avoid this defect, and to make the apparatus more effective by exposing a greater moving surface of liquid to the action of the gas, each rotary member in the present arrangement consists of curved or inclined or curved and inclined blades, connected to a rotating shaft, and arranged with their lower edges in the liquid, "so that the motion of the blades causes the liquid to flow up and over their advancing surfaces, and then to fall in a heavy spray into the body of liquid in the chambers."



Sumner's Gas-Washer.

An illustration is given of the machine in part sectional elevation; also a plan from below of one of the sets of blades, an elevation of same, and a plan from above—part of the disc being removed to show a blade and part of the hood.

The apparatus consists of a set of chambers through which gas from the inlet pipe B flows upwards through central pipes and (purified) finally leaves by the pipe L. In each chamber there is fixed to a vertical rotating shaft a disc E carrying a hood F, to deflect the gas, and two or more blades G, preferably inclined, which have their lower edges immersed in the liquid (not shown), "so that the motion of the blades causes the liquid to flow up and over their entire surface and then fall in a heavy spray." The gas, in passing through each chamber, must therefore pass between the wetted blades and through the spray.

The liquid enters the top chamber and flows from each chamber to the one below, by pipes H arranged outside the chambers. The shaft is driven by an engine belt attached to the pulley K at the base of the shaft. One hundred revolutions per minute is said to be a suitable speed.

The blades must be so curved and inclined as to ensure that their movement will cause the liquid to flow up and over the advancing surfaces; while fixed blades may be employed to prevent the whole body of liquid in the bottom of any chamber rotating too rapidly.

High-Pressure Gas-Meters.

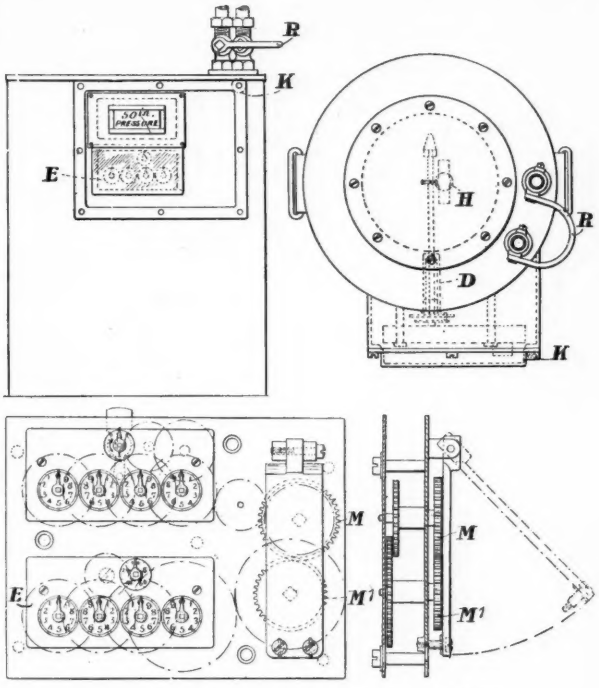
GOW, J., and the GAS-METER COMPANY, LIMITED, of Kingsland Road, N.E.

No. 28,863; Dec. 21, 1911.

This invention relates to high-pressure gas-meters in which the index reading is adjusted for the diminution in the volume of the gas owing to compression.

It has been proposed, the patentees remark, to construct gas-meters with an ordinary index or counter, and a second counter adapted to register the money value of the supply at a special rate, and which may be adjusted by means of change-wheels. Meters with one or more counters whereby registration is obtained of the total gas supplied, reckoning high-pressure gas at a greater rate, have also been proposed. But, according to the present invention, the meter is constructed with a double index, one of which is an ordinary index adapted to record the number of cubic feet of gas delivered, while the other is continuously driven from the first through change-wheels adapted to increase the reading so as to compensate for the diminution in volume when high-pressure gas is measured. The compensating index is actuated from the low-pressure index through a train of wheels comprising change-wheels for varying the speed ratio according to the pressure used. For example, if it were desired to add 12 per cent. to the compensating index, this could be effected by inserting in the train of the compensating index change-wheels having 56 and 50 respectively. It is estimated that one-inch extra pressure of water would make a difference of $\frac{1}{402}$ in the volume of gas supplied, or each 4 inches of extra water pressure would represent a diminution in the volume of gas of approximately 1 per cent.

However (as they point out), a small allowance may be made to the consumer; and for a meter working at 50 inches pressure, 12 per cent. would be added to the compensating index. Such a meter is illustrated,



Gow's (Gas-Meter Company) High-Pressure Meter.

Figs. 1 and 2 are an elevation and plan of a meter with a compensating index constructed according to this invention. Fig. 3 is a front elevation of the double index with the cover removed. Fig. 4 is a vertical section. The double index and index mechanism are mounted in a box outside the meter casing, and driven by a spindle which passes through a long stuffing-box D in the casing. This spindle is driven by a worm H mounted between two inverted U-shaped brackets or bridges; the worm being driven by the usual meter mechanism (not shown) which is exposed when the cover is removed. In order to facilitate their insertion and removal, the change-wheels M M^1, mounted on the squared ends of spindles, are held in position by a hinged plate secured by screws, which prevents the unauthorized removal of the wheels. The upper change-wheel M would have the greater number of teeth, as will be readily understood.

The compensating index E is placed immediately below the ordinary index F, and a plate fixed by screws is sealed at K.

In order to prevent variations of pressure in the meter through the inlet and outlet valves not being opened or closed to the same extent, these valves are coupled together, so that they are actuated at the same time, and at the same rate in opening or closing, and thus kept in the same relative positions. This is effected by forming both keys on a single U-shaped handle R.

Automatically Lighting and Extinguishing Gas-Burners.

DUTCHMAN, E., of Tokenhouse Buildings, E.C., FAWCETT, A. S., of Sheffield, JESSOP, S., of Hathersage, and TRAVIS, W. J., of Sheffield.

No. 29,249; Dec. 29, 1911.

This apparatus works on the "wave system." It consists of means for lighting and extinguishing the gas of burners used in conjunction with pilot jets at given times—say, first at dusk for lighting up only; secondly, at midnight for extinguishing surplus lights in cluster lamps without extinguishing single-light lamps; and, thirdly, for extinguishing the whole of the single-light lamps then burning.

Fig. 1 is a sectional elevation of the device. Fig. 2 is an elevation showing the upper gas-chamber in longitudinal section. Fig. 3 is a plan. Fig. 4 is a transverse section of the upper gas-chamber, on the line X of fig. 2. Fig. 5 is a longitudinal section of a gas-chamber provided with two hollow drums. Fig. 6 is a transverse section on the line Y of fig. 5, showing the port to the burner open.

The inventors employ a regulating device below (or in close proximity to) the burner, which consists of a bell trap A sealed in mercury, glycerine, or some other suitable fluid. The bell is placed over a gas

reservoir C, which is in communication with the pipe D. The outer case containing the bell and trap has a jointed cover, through the centre of which is an orifice leading into an upper gas-chamber F. Through this orifice a hollow stalk G passes, with its bottom end open to the gas-pipe D, and sliding in a vertical cylindrical guide fixed to the interior of the trap bottom. The stalk G is provided with holes below, so that the gas may pass into the reservoir C, and thence, through smaller holes, into the stalk G. This stalk is secured to the bell of the trap, which is recessed to receive a second or supplementary bell trap I sealed in some suitable fluid; the top of this second trap forming a guide for the stalk G passing through it—both projecting into the upper gas-chamber F. This upper chamber, circular in form, is at right angles to the hollow stalk, and is placed to one side of the reservoir cover, so that when the stalk and its top guide project into it they are to one side of the horizontal centre line of the upper chamber.

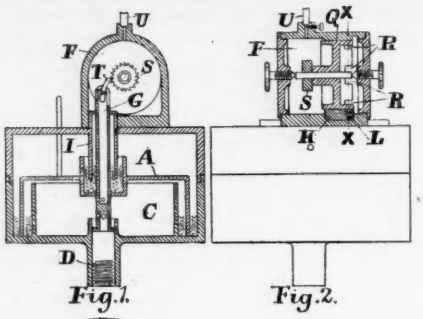


Fig.1.

Fig.2.

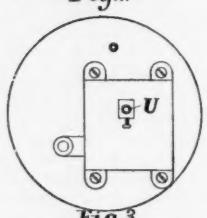


Fig.3.

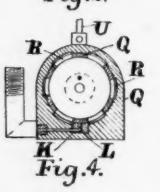


Fig.4.

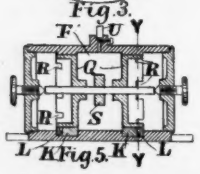


Fig.5.

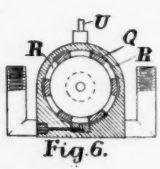


Fig.6.

Dutchman's Automatic Lamplighter.

On the top of the stalk G is attached a small catch or pawl T, so placed as to engage with a ratchet wheel S, so that when the abnormal wave pressure of gas is turned on it acts on the inside of the main bell A, which is then lifted, and, by means of the stalk G, the catch or pawl moves the wheel S in the upper gas-chamber one notch forward. Assuming that the hollow drum has been previously set to extinguish the light, the slotted port R, in the periphery of the hollow drum Q, which is nearest the hole L in a bush K, would be moved a sufficient distance to uncover the orifice in the bush, and thereby allow the gas to pass from the upper gas-chamber—first, in a downward direction, then horizontally, and finally in an upward direction—to the burner; and as the pilot jet is always alight (being supplied by a branch U direct from the upper gas-chamber) the jet from the burner would be immediately lighted.

When the wave pressure has been taken oft, the bell A would drop until the next wave pressure occurred, which would be (say) at midnight, when the drum Q would be moved by the pawl T and ratchet wheel S one step further, until the other end of the slotted port was brought opposite the hole in the bush, so that the light would continue to burn until another wave pressure occurred at (say) daylight, when, by the action of the bell, the ratchet wheel would be again impelled forward so as to place the periphery of the hollow drum in a position to cover the orifice L, in the bush K, through which the gas passes to the burner (as shown in figs. 2 and 4), thereby extinguishing the light from the main burner, but leaving the pilot jet alight.

When the invention is to be arranged to operate in conjunction with cluster jets on the same service, a second hollow drum Q (shown in figs. 5 and 6), in the upper gas-chamber F, is mounted on the same spindle as the first-mentioned hollow drum with the ratchet wheel S —by preference between them. The periphery of this second drum is also provided with slotted ports R at suitable intervals, and in unison with one or more teeth of the ratchet wheel. There is also provided a second bush K in the bottom of the upper gas-chamber, with a central port L for the passage of the gas to the burner, and over the curved surface of which the periphery of the last-named drum passes when it is rotated.

By this arrangement—assuming the second hollow drum to have been previously set like the first one—when the evening wave pressure occurs, the port in the periphery of the drum nearest the hole L in the bush K would be moved, by means of the ratchet and pawl, so as to uncover the hole, and thereby allow the gas to pass from the upper chamber F through the ports in the drum and the bush to the several burners, which would be lighted by a pilot jet as before described. When the second wave pressure occurs (say) at midnight, the second hollow drum Q, although rotating at the same time as the first drum, is provided with shorter slots; therefore the orifice L in the bush would then be covered, and the supply of gas to the cluster lights cut off, so that they would be immediately extinguished, while the single light regulated by the first hollow drum would continue alight. The orifice in the bush would still remain covered after the third wave pressure occurs—say, at daybreak. But the next movement of the bell, which would take place when the early evening wave pressure occurred, would again uncover the hole in the bush, and thereby the outlet to the burner, and the cycle of operations would be repeated.

Gas Flash Light Devices.

JACKSON, T., of New Cross, S.E., and RAMSAY, A., of Folkestone.

No. 28,523; Dec. 18, 1911.

This invention consists in the combination of gas-motor mechanism operated by the pressure of the gas used for flashing purposes in one set of burners (such, for example, as are described in patents No. 4438 of 1910 and No. 20,368 of 1911) with a rotary drum device for supplying a number of separate pipes of another gas distributing system and means for controlling the supply of the gas to each pipe with periodic variations, so that any desired combination or sequence of individual lights of the second system can be dealt with in any predetermined manner.

Rotary Gas-Engines.

AUGUSTINE, B. F., of Buffalo, U.S.A.

No. 4297; Feb. 20, 1912.

This invention specially refers to the kind of engine described in patent No. 9458 of 1911—a rotary engine particularly adapted for use with steam as the operating medium, but which (as stated in the specification) may also be operable as an internal combustion engine by the use of gas as the driving medium. The present invention relates to such constructional details and improvements as are necessary for the purpose of adapting the engine as an internal combustion engine.

APPLICATIONS FOR LETTERS PATENT.

28,369.—M'DOUGALL, I. & S., and HOWLES, F., "Treatment of tar, tar distillates, and their products." Dec. 9.

28,404.—MAUDE, J., "Suction gas plant." Dec. 9.

28,446.—BENTON, W. A., "Gas-compressors." Dec. 10.

28,477.—M'COURT, C. D., and BONECOURT SURFACE COMBUSTION, LTD., "Combustion of liquid fuel." Dec. 10.

28,478.—M'COURT, C. D., and BONECOURT SURFACE COMBUSTION, LTD., "Generation of steam." Dec. 10.

28,494.—STIMSON, E. F., "Gas-heated circulators." Dec. 10.

28,496.—LANGHANS, R., "Incandescent gas lighting." Dec. 10.

28,501.—LANGHANS, R., "Incandescent gas lighting." Dec. 10.

28,504.—TANGYES, LTD., and ROBSON, J., JUN., "Gas-producers." Dec. 10.

28,533.—ALLDAYS AND ONIONS PNEUMATIC ENGINEERING COMPANY, LTD., and NICHOLSON, A., "High-pressure gas supply." Dec. 11.

28,549.—CHARLTON, J., "Cooling producer gases, and the production of salt." Dec. 11.

28,550.—FLETCHER, RUSSELL, AND CO., LTD, and FLETCHER, T. W., "Atmospheric gas-burners." Dec. 11.

28,559.—MITCHELL, A. M'G., and STRATHERN, A. G., "Gas cooking-stoves, boiling-rings, &c." Dec. 11.

28,560.—MEIN, B. M., and SERSHALL, S. H., "Taps or cocks." Dec. 11.

28,582.—PARKER, O. J., "Treating carbonaceous material." Dec. 11.

28,653-4.—HAVERS, E. W., "Distance gas lighting." Dec. 12.

28,659 —EDMUNDS, H. M., "Measurement of the flow of gas in pipes." Dec. 12.

28,695-6.—HART, J., "Acetylene generators." Dec. 13.

28,698.—TWYNAM, T., "Recovery of ammonia in gas manufacture." Dec. 13.

28,791.—MOELLER, J., and WOLTERECK, H. C., "Manufacture of coke." Dec. 14.

28,822.—KIRKE, P. St. G., and BONECOURT SURFACE COMBUSTION, LTD., "Injectors." Dec. 14.

A Peculiar Compensation Case.

Last Tuesday, a somewhat remarkable case under the Workmen's Compensation Act was heard at Southport, when Peter Bradshaw sued the Formby Gas Company for the loss of vision, alleged to have been caused by an accident in the course of his employment at the gas-works. On behalf of the applicant, it was stated that on Sunday night, May 18 last, he was employed on duty in the retort-house, when some dust was blown into his eyes. Following this, one eye became inflamed, and subsequently the sight became worse. Ultimately, notwithstanding efficient treatment by specialists, the right eye was stated to be sightless. In reply to this, the respondent Company contended that the eye in question was in as bad condition prior to the accident as subsequently. Medical evidence was given by Dr. Stephenson, of Liverpool, who affirmed that he knew cases in which people had been blind in one eye without knowing it; and one instance was cited in which a man was blind in one eye from birth, and was not aware of it until he was forty years of age, at which period of his life an examination of his eyes was necessary. His Honour Judge Thomas gave a verdict in favour of the Company, with costs.

Tendring Hundred Water Company's Affairs.—In the King's Bench Division of the High Court of Justice last Friday, before Justices Ridley, Phillimore, and Bankes, Mr. P. J. G. Henriques moved, on behalf of the Tendring Hundred Water-Works Company, that all proceedings under a writ of *mandamus* issued so long ago as 1900 might be stayed, and that the return to the writ might be taken off the file. Mr. Justice Bankes asked if this was necessary, seeing that nothing had been done for so many years. Mr. Henriques said the Directors were very anxious that the return should be taken off the file. Mr. Justice Ridley asked if the application was by consent. Mr. E. H. Tindal Atkinson, who appeared for the Harwich Corporation, said he consented. The application was granted.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

Carbonization in Vertical Retorts.

SIR,—I think for a guiding principle the "Correspondence" columns would, if it could, choose Shakespeare's "Out with it boldly; truth loves open dealing," rather than "Consistency's" "that exactness of truth" which savours of truth qualified.

"Consistency's" contribution in your issue of the 17th inst., shorn of its cloak of righteousness, reads: "In no part of my letter published in the 'JOURNAL' for Nov. 19 can any such references be found as 'free spaces,' 'less dense coke,' or 'exit of evolved gases.'" I have re-read his letter, and I repeat that such references are all contained therein; and therefore it devolves upon me to explain my rendering of his former letter, which commences thus: "I ['Consistency'] have read with interest Mr. Nelson's letter published in your last issue, which is both welcome and opportune in further avoiding 'such condemnation' of the Dessau system of vertical retorts by laying at its door, as was attempted at the Birmingham meeting, 'something' which never happens."

"Consistency" having withdrawn from the discussion, I cannot do less than state my rendering; and I say that the word "something" in his letter refers to the "difficult exit of evolved gases" and "the too heavy and dense coke," and that the words "such condemnation" refer to the "packing of the charge" as referred to by Mr. Bell at the Birmingham meeting.

Also, "Consistency" says: "The diagram given by Mr. Drury in his paper last year was strongly supported by the more recent chart given with Mr. Nelson's paper. The following figures will prove something towards the density of the charge in proportion to the mass liberated per second. These particulars are given with full knowledge, from careful observations extending over many months' working a large installation of Dessau vertical retorts." My understanding is that this "something" has a reference solely as a measure of the porosity, interstices, or free spaces intentionally formed within the charge by a special mode of charging.

H. J. TOOGOOD.

Elland, Dec. 20, 1912.

Stresses in Roof Trusses.

SIR,—In reference to Mr. Pye's diagram of stresses in a roof truss, illustrated in the current number of the "JOURNAL," I think it should be pointed out that no one in his senses would dream of distributing an isolated load uniformly over the truss when working out the stresses on such a structure. One might as well suggest that a beam subject to an isolated load, placed anywhere across the span, is likely to be treated as a beam having the same load uniformly distributed. Anyone who could fall into such errors should never be entrusted with the design of any structures of the kind.

But Mr. Pye's treatment is open to criticism. Properly speaking, the loading on one-half of the truss should not be vertical, but inclined, to suit the wind pressure; and it must be remembered the wind does not act on both sides at once, as Mr. Pye assumes. This would cause still greater variation in the stresses. Moreover, the stresses will be found to vary according to whether the right or left hand support is considered fixed. Therefore, to be perfectly safe, diagrams should be constructed showing the stresses due to these varying conditions.

All this, however, may be found in the ordinary elementary text-books or graphical statics—notably Bow's "Economics of Construction," one of the oldest and perhaps the best text-book on the subject ever published. Bow's system of lettering the diagrams, and tests of accuracy, revolutionized the graphical determination of stresses throughout the world. It converted in an instant the most confusing problems into the most simple and delightful exercises.

F. S. CRIPPS.

St. Stephen's House, Westminster, Dec. 19, 1912.

Indirect Lighting Effects.

SIR,—I am grateful to you for having given such a complete abstract of the paper, on "Indirect Lighting," read by the writer and Mr. Wheat before the Illuminating Engineering Society on Tuesday, the 3rd inst.

I would ask leave, however, to reply to the criticism at the end of your abstract—referred to as a criticism of a member of the Society. He alluded to the effects produced by the indirect fitting installed in the lobby adjoining the meeting room, following the suggestion of a member that the meeting hall lights should be extinguished so that the audience would have the opportunity of seeing the effect of the lighting in the lobby. And, in reply to the question, "What did they see?" he makes a very unfavourable statement of the effects.

In this statement, your contributor either does not appreciate certain essentials of illumination, or neglects to consider them. The lobby in question had a dirty yellow ceiling (not white as he stated), dark side walls, and dark furniture and trimmings. The result, of course, was that very little light was reflected from the side walls, furniture, and trimmings; and they appeared dark. One should not infer from this, however, that there was not good illumination in the room from the indirect fitting. This was readily shown when one went into the lobby and held a book or paper before him, when the excellent illumination was clearly seen. It was also clearly shown in the illumination of the marble bust in the lobby, which was brought out in full detail. The effect your contributor mentions would have been the same even with daylight coming in through the ceiling from a skylight. There would have been plenty of light and illumination, as there was from the indirect fitting; but the dark side walls and the furniture would not have reflected it to the observer in the adjoining meeting hall.

It was, therefore, no proper method of judging the effect of indirect lighting by looking at the result from the adjoining meeting hall; and your contributor's comments thereon are inconclusive. If he had only taken the trouble to go into the lobby, and test the illumination at various parts of it, he would have found it ample, uniform, and agreeable.

I do not understand the last sentence of his comment, which states: "What is wanted is something more than eye-test or visual efficiency set out in terms of figures"—*i.e.*, comfort in seeing, and cheerfulness of general surroundings. If he means that indirect lighting does not produce comfort in seeing and cheerfulness in general surroundings, then he has something to learn about the effects of this system, in which these features of comfort and cheerful surroundings are the principal advantages.

As I stated in the paper, it is impossible to describe the results given by the "eye-rest" system of indirect lighting. It has to be seen to be understood and appreciated; and I would extend a cordial invitation to your contributor to meet the writer, and see some of the excellent examples of indirect lighting in actual service. The remarkable feature of this system has been the marked favour with which it has been received by everyone employing it. The criticisms and comments at the meeting all fail beside this fact; and as the "proof of the pudding is in the eating," the proof of the value of this indirect lighting system is in the success and favour which attend its use.

F. W. WILLCOX.

British Thomson-Houston Company, Upper Thames Street, E.C., Dec. 16, 1912.

Gas Coming by its Own.

SIR,—We have taken an unusual interest in the letter appearing under the above head in your issue of Dec. 10, written by Mr. Edward A. Harman, of Huddersfield. We should like to take this opportunity of further endorsing Mr. Harman's contention that the British Commercial Gas Association has made its influence very widely felt throughout the gas industry. There is no doubt whatever that all firms contracting for the supply of gas companies' requirements have been exceedingly busy during the present year. We know of two or three cases where firms are spending many thousands of pounds in extensions; and, speaking for ourselves, we may say that 1912 has been a record year for us as regards output. We have already started on very large extensions to enable us to cope with this extraordinary boom in gas appliances, which has undoubtedly been brought about by the untiring efforts of the British Commercial Gas Association. We think it must be evident to everyone that the Association referred to has done a tremendous amount of work to popularize gas apparatus of every description; and it is obvious that the more support the Association receives the better it will be for everyone interested in the welfare of the gas industry.

In conclusion, we can only express the hope that the tendency indicated by the paragraph to which Mr. Harman calls attention may continue to spread, to the benefit of the gas industry as a whole.

THE DAVIS GAS-STOVE COMPANY, LIMITED,
CYRIL G. DAVIS, Managing-Director.

59, *Queen Victoria Street, E.C., Dec.* 18, 1912.

LEGAL INTELLIGENCE.

DAMAGES FOR INJURIES TO A WORKMAN.

At the Wandsworth County Court, on Monday last week, before his Honour Judge Harington and a Jury, Albert Edward Alton, a plumber, sued the Wandsworth and Putney Gas Company for £100 damages in respect of personal injuries. Plaintiff was at work on a sink in the scullery at a house called "The Laurels," in which workmen from the Company were engaged in doing some gas-fitting; and his evidence was to the effect that a pair of grips, weighing about 10 lbs., used by them, fell on his back and seriously injured him. There was a pageant at "The Laurels" in the evening, and witness went in for about half-an-hour. He returned to his work next day, but was not fit to do much; and in the evening he went to see Dr. Thyne. The accident occurred in July. Subsequently he attended the Bolingbroke Hospital, and his back was bandaged. From July till September, he said, "the lower part of his back seemed detached from the upper part." Arthur Alton, plaintiff's brother, deposed that on the day of the accident the gas-fitters were working in the scullery immediately over the spot where his brother was standing. Dr. J. T. Thyne said the plaintiff came to him in July and complained of pain caused by something having struck him. Witness advised him to go to the Bolingbroke Hospital. Dr. Mercer said he had examined Alton in consultation with the Company's doctor, and expressed the opinion that a pair of grips falling on to the middle of the back would cause the symptoms he found.

For the defence, Dr. Davis said he had examined the plaintiff, and did not see any signs of physical injury; and he thought the case had been exaggerated. Robert Bryan, a gas-fitter, said he had made holes in the walls and began to fix the pipe. Up to that time no one was in the scullery. In order to bring out the pipe a little further, he put the grips into the hole and used them as a wedge. Witness heard someone come in and go to the sink. He looked down, and just then the grips clicked against the second pipe. The water-pipe was loose, and the shaking of it would disturb the grips. Alton did not give any warning that he was going to work below. After the grips fell, witness expressed his regret; and Alton replied: "All right; it was an accident, and could not be helped." Philip Merry, the last witness's mate, said he had left the scullery, and when he returned he saw Alton getting up after the grips had fallen upon him. He did not make any complaint against Bryan. Mr. W. H. Cromarty deposed that when the plaintiff called at the Company's office he did not complain of Bryan's conduct; he merely said the grips had fallen on his back. Dr. Howell said he examined Alton soon after the accident, but could not discover any evidence of injury, though the man's back was painful.

After a few minutes' deliberation in private, the Jury returned a verdict for the plaintiff, and awarded him £25.

MISCELLANEOUS NEWS.

MR. CHARLES CARPENTER AND HIS CO-PARTNERS.

A Seasonable Address.

The number of the "Co-Partnership Journal" of the South Metropolitan Gas Company for the Christmas season opens with an address by Mr. Charles Carpenter, the Chairman of the Company. It bears the title of "There's 1912 for Remembrance," and is as follows.

The year which draws to a close as these lines are being written has been one of great anxiety to the Directors of the Company. Its dawn saw them busily endeavouring to accumulate, at large expense, such stocks of coal as would enable our obligations to be met during the threatened coal strike. Its close finds them confronted with the shortage of supply arising out of a stoppage in production which struck a cruel blow at the well-being of the entire community. The co-partners of this Company would be the last to deny the right of every worker to fair pay and reasonable hours; but I am certain that knowledge of the dependence of the kingdom upon the industry of its inhabitants to provide by their toil for its necessities, would never have misled them to think that good could come from a national stoppage of coal mining. Cheap fuel as well as cheap gas are necessities everywhere, but nowhere more than in South London, which does not profit by a "boom" in trade to the same degree as the large manufacturing towns. It was with this knowledge that the price of coke was kept unchanged during the continuance of the strike; thus sacrificing the extra profit which might have been made to the general good of the district with the prosperity of which our own undertaking is so intimately bound up. Every endeavour will also be made to do the same as regards the price of gas, though the heavy cost of raw material is straining our resources to their utmost. A very simple statement will bring home to our co-partners the magnitude of this difficulty. The increase in cost of only 1d. per ton of coal means an expenditure by the Company of £5000 per annum. When it is borne in mind that coal is dearer by shillings instead of pence per ton, the seriousness of these figures will be apparent to everyone.

Let us, however, turn from the dark side of our business to a brighter one, and seek some better event than the coal strike or the troubles which have attended it by which to earmark the year 1912. Such a one will be found in the extension of the eight-hour day as the basis of employment throughout the whole of our business, instead of confining it to our manufacturing and chemical departments. I well remember the gloomy forebodings which were uttered when, nearly twenty-four years ago, this concession was first made by the Company to the retort-house men. "What will they do with themselves when they are not at work?" was a question often put, and as often despairingly answered. A few months' experience at Vauxhall soon proved the advantages of the shorter hours; and when the stokers' strike happened, we took a leaf out of the log of the great Admiral who put the telescope to his blind eye, and, though more men had to be housed, fed, and trained, the gangs were all made up through those troublous weeks on the eight-hour system.

The boon of the shorter working shift has been an incalculable one to the carbonizers; and experience has shown that the large majority use their leisure profitably, and have become, and are becoming, more healthy and intelligent citizens than was possible when they were at the works for 72 and 84 hours per week. From time to time since 1889, various concessions in pay or time have been made in other departments; the most notable being the extended interval for breakfast, and all of them, it is interesting to record, without any pressure on the part of the employees. The instance I am discussing was no exception to the rule; and I cannot recall any occasion when greater unanimity of opinion was shown by the Directors than in regard to the proposal of adopting an eight-hour day without loss of pay. Co-partners will, I am sure, view their action in the matter as proving that, notwithstanding all the anxieties inseparable from an undertaking carrying such heavy responsibilities of management, they are never unmindful of the welfare of their employees.

Reference to the history of the passing year would be incomplete without mention of the splendid work done by the members of the Co-Partnership Committee in placing upon a sound and, it is hoped, enduring basis the Provident Society, which will in future take the place of the old-established Sick Fund. The Sub-Committee especially deserve great praise for the British manner in which they stuck to their guns over a certain knotty point on which they did not see eye to eye with the insurance officials; and their victory is most creditable to them, as it was necessary to the proper administration of the Society. The Co-Partnership Committee will have still wider duties in future by reason of the fact that it has been entrusted with the management of the new undertaking. It is to be hoped this arrangement will long continue, for all sections of the employees have elective representation upon it; and it would be difficult to conceive a more useful body for promoting efficient and harmonious working than it has been for so long a time.

More than 250 years ago, a London poet, by name John Milton, published the immortal plea for liberty to which he gave the awkward name of "Areopagitica." We need not bother ourselves now with the meaning of the title; but early in the discourse occurs the following sentence (it is printed in the original spelling): "For this is not the liberty which wee can hope, that no grievance ever should arise in the Commonwealth, that let no man in this world expect; but when complaints are freely heard, deeply consider'd and speedily reform'd, then is the utmost bound of civill liberty attain'd, that wise men looke for." The liberty which Milton pictures in these words is that accorded to all employees in this Company's service; and the Co-Partnership Committee may truthfully be described as the guardian of that great privilege, without which peace might be disturbed by discontent.

With remembrance, therefore, of the heritage 1913 will bring for all co-partners, I feel it is no empty compliment to wish them

A Happy New Year.

LEEDS UNIVERSITY LECTURES.

Department of Coal Gas and Fuel Industries.

In connection with the work of the Department of Coal Gas and Fuel Industries at the University of Leeds, arrangements have been made for the delivery of the following special courses of lectures on (i.) the Distribution and Uses of Coal Gas, and (ii.) Bye-Product Coking Processes, by gentlemen who are acknowledged authorities on their respective branches of fuel technology. The courses will be open to all persons engaged in either of the industries concerned.

I.—THE DISTRIBUTION AND USES OF COAL GAS.

A course of twenty lectures, to be given on Wednesdays, at 6 p.m., and Thursdays, at 9 a.m., during the second term, commencing Wednesday, Jan. 8, 1913, and continuing until Thursday, March 20, 1913, as follows:—

Jan. 8 to Jan. 30.—Eight lectures on "Distribution of Coal Gas," by Mr. Walter Hole, of Leeds.

General principles. Proportioning of mains. The distributory system. Pressures. High-pressure distribution. High-pressure lighting. Hygiene of gas lighting. Gas in competition.

Feb. 5. to Feb. 13.—Four lectures on "Combustion and Structure of Flames," by Professor Cobb (2) and Professor Smithells (2).

Feb. 19 and 20 and March 5 and 6.—Four lectures on "Gas Heating" (1), "Gas-Fires" (1), and "High-Pressure Gas" (2), by Mr. E. W. Smith, M.Sc., Chief Chemist, Gas Department, Birmingham.

The practical application of flames. Conservation of heat. Domestic and industrial heating. Natural draught and air blast. Construction of fires. Fuels. Burners. Flues. Canopies. Air-regulators. Efficiencies. Hygienic considerations. Compressors. Cost of compressing. Theoretical considerations. Effect of compression on gas. Connections. Governors.

March 12 to March 20.—Four lectures on "Gas Lighting and Photometry," by Mr. Jacques Abady, of London.

Light: Fundamental laws. The spectrum. Energy of light production. Artificial lighting. Elementary principles. Diffusion. Glare. Contrast. Reflection. Obstruction. Gas lighting. Evolution. Factors in gas combustion. The mantle. Arrangement of street-lighting units.

Photometry: Fundamental laws. Practical application. Measurement of light sources. Measurement of illumination. Measurement of energy.

Fee, £1 1s. for the whole course, or 10s. 6d. for a single section of it.

It may be pointed out that the arrangements for the course will enable students living at a distance from Leeds to attend two lectures by staying one night per week in Leeds. Overnight accommodation for a limited number of students can be provided at Lyddon Hall, the hall of residence of the University, at an inclusive charge of 6s. for dinner, bed, and breakfast. Early application for such accommodation should be made to the Warden, Lyddon Hall, Leeds. Students are, however, at liberty to make other arrangements; and, if desired, the Secretary of the University will be glad to supply a list of registered lodgings.

II.—BYE-PRODUCT COKING PROCESSES.

A course of eight lectures by Dr. M. G. Christie and Mr. W. Greaves, of Leeds, on Saturday afternoons, at 3.30, commencing with Saturday, Jan. 18, 1913.

(i.) The lectures by Dr. Christie will comprise: A general outline of the chemical aspects of dry distillation, with special reference to the carbonization of coal. Possibilities of research in the chemistry of coal and of carbonization.

(ii.) The lectures by Mr. Greaves will comprise: General description of the development of bye-product coking, with its accessory processes—such as the manufacture of ammonium sulphate and chloride, concentrated ammonia liquor, the recovery of cyanogen and sulphuretted hydrogen, the distillation of tar, the manufacture of tar macadam. The utilization of coke-oven gas for town lighting, power, and for the production of lampblack. Technical discussion of the various types of modern coking installations. The control of such plants and the examination of coking coals.

Each lecture will be followed by a short class for discussion on the scientific control of a bye-product coking plant.

Fee, £1 1s. for the course.

Intending students are requested to send in their names without delay to the Secretary of the University, specifying at the same time the course or courses which they desire to attend. The fees for the respective courses are payable in advance on the date of the first lecture. Other inquiries regarding the courses should be addressed to Professor Cobb, the head of the Department of Coal Gas and Fuel Industries.

METROPOLIS GAS SUPPLY.

Deficient Illuminating Power through the Coal Strike.

At the Meeting of the London County Council last Tuesday, the Public Control Committee reported that the returns of the Council's gas examiners showed that there had been a deficiency of illuminating power in the gas supplied by the Gaslight and Coke Company at several testing-stations on various dates in March and April last, and, further, at Kingsland Road on the 27th of May, at Spring Gardens on the 13th, 14th, and 15th of June, at Ladbroke Grove on the 18th of June, at Hornsey Road on the 27th of September, and at George Street on the 30th of September and the 1st, 2nd, and 3rd of October. In

each case the Company lodged an appeal; and the cases were heard by the Chief Gas Examiner at the office of the Metropolitan Gas Referees on the 7th ult. At the hearing, the Council did not press for forfeitures in respect of the deficiencies during the period of the coal strike and the subsequent period affected by the strike; and it was suggested, on behalf of the Council, that the deficiencies should be regarded as due to unavoidable cause or accident. The award of the Chief Gas Examiner was issued on the 23rd ult., and it provides that, in consequence of the coal strike, the deficiencies up to the end of June might reasonably be regarded as due to an unavoidable cause, and that the reports must accordingly be annulled. In the case of deficient illuminating power at Hornsey Road on the 27th of September, a forfeiture of £25 was imposed. As regards the four cases of deficiency at George Street during September and October, the Chief Gas Examiner decided that the reports must stand. In all these five cases, he certified that the default of the Company was not substantial, nor due to careless conduct of the Company or their servants. The report was received.

CORPORATION EMPLOYEES' HOURS OF LABOUR.

The Manchester City Council Reject a Forty-Eight Hour Week.

The Manchester City Council, at a special meeting held last Wednesday to clear off business left over from the previous sitting, considered a proposal put forward by Mr. James Johnston that a Committee be appointed to inquire into the desirability of limiting the hours of all Corporation employees to 48 per week. When introducing the matter, Mr. Johnston, having asked the Council to note that it was a 48-hour week he aimed at, and not an eight-hour day, proceeded to say that the question had passed beyond the academic stage, and argued that the wisdom of the policy he advocated had been proved by the experience of co-operative societies and such large private concerns as Messrs. Brunner, Mond, and Co., Limited, and Messrs. Mather and Platt, Limited. In all cases the evidence was to the effect that with shorter hours the men were fresher and did their work better, and that the cost to the employing firm was in the end no greater than under the old system.

The members of the Council who spoke in opposition to the proposal pointed out that there was no demand on the part of the workmen for a 48-hour week, and that, if conceded, the change would mean a serious financial burden on the ratepayers. Mr. F. J. West, as a large employer of labour, while admitting that Mr. Johnston had presented the best possible case, submitted that if the various instances put forward by him were analyzed, it would be found that they were not comparable with the Manchester Corporation. They were cases where the work was continuous—eight hours, and no break for meals. Mr. West asked the Council to consider the subject from the economic standpoint. Assuming that £500,000 was paid in wages to workmen each year, a reduction of working hours to 48 per week without a corresponding reduction in wages would mean an increase of £50,000 a year in the wage bill, or 3d. in the pound on the rates.

By a large majority, the Council rejected Mr. Johnston's proposal.

SERIOUS ELECTRICITY SUPPLY TROUBLES.

Fire and Failure of Current at Salford.

A fire which occurred at the electricity works of the Salford Corporation in the early hours of last Thusday morning had very serious results. Besides damage estimated at about £10,000 to the plant and building, the whole service was disorganized for the remainder of the week. Works dependent on electricity for power and light had to close-down; many of the streets had to remain unlighted at night; theatres and picture halls could not, in the majority of cases, open their doors to patrons; shop-keepers with electric light installations had to resort to candles where the gas-fittings had been taken out; and the tramway service was only partially maintained, by the help of the Manchester Electricity Committee and other local authorities having an electricity department.

The origin of this disastrous condition of affairs, says our Manchester correspondent, was simple. A workman engaged in the testing-room dropped a spanner, and the tool caught a "live" wire in its fall. Immediately, according to the employee, there was a blaze; and the flames, spreading with amazing rapidity, soon involved the whole block of buildings at the seat of the outbreak. The Fire Brigade, with full strength on duty and equipment in use, were more than two hours subduing the fire. Interviewed on Thursday forenoon, Mr. Hawkins, the Chief Electrical Engineer to the Corporation, could not state definitely the cause of the outbreak. It spread from the traction supply to the lighting and power supply, and involved the switchboards for lighting and power traction, including the supply to Prestwich, which is given from the Salford station. "The fire," he added, "is undoubtedly a serious one, and one which we do not want to see again in the North of England. It is not because it has spread, though it spread very rapidly indeed; but it has hit the undertaking in a vital spot." Mr. Hawkins said there was no chance of even a limited service for lighting and power before the week-end, so extensive and serious had been the damage done. At night, the borough was in semi-darkness; and shop-keepers had to resort to all kinds of artificial lighting-up for the conduct of business. Those who had retained their gas-fittings had good cause for congratulating themselves on having taken this precaution.

The demand for gas in consequence of the accident did not increase to the extent that might have been expected. The Gas Engineer (Mr W. W. Woodward) said this was due to the fact that many people, when having the electric light installed, did away with their gas fittings and meters. Those who had retained them reverted to the old illuminant, with the result that Thursday's and Friday's consumption showed a fair

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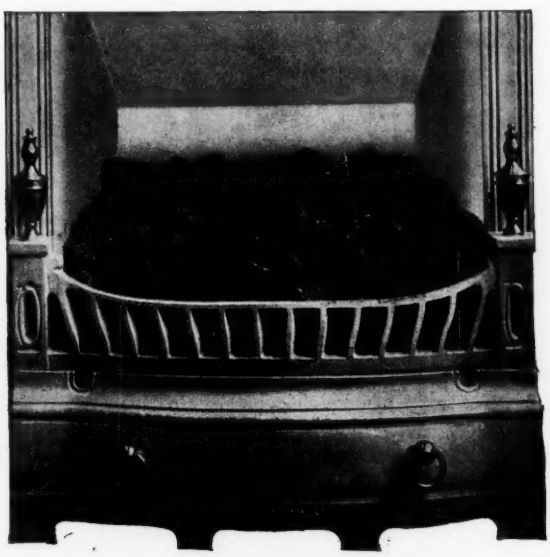

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increase compared with the corresponding days in the previous week. At the Salford Town Hall, the limited gas jets available led to the use of candles at dusk.

Failure at Sheffield.

For about a quarter of an hour last Tuesday afternoon, when Christmas shopping was at its busiest, there was a failure of the Corporation electric supply in Sheffield; and widespread inconvenience was caused to the tradesmen of the city. The breakdown, which was caused by a fault in one of the generating machines at Neepsend, was general throughout Sheffield. The inconvenience was minimized in many establishments by the utilization of gas, where the fittings had not been removed; and in other places the firms were fortunate in the fact that they always use their own plant to provide the electricity. In the majority of cases, however, there was a rush for candles, and even night-lights had to do duty in some instances. In the case of one firm, the counters on the ground floor are all illuminated by gas, and business was therefore uninterrupted. The upper floors, however, which contain extensive show-rooms, are lighted exclusively by electricity, and crowds of customers were passing to and fro when the light failed. There was instant confusion, and people shopping on the ground floor in the gaslight were considerably surprised when some hundreds of customers came streaming down the staircases from the show-rooms above. The manager of another large establishment declared that this was the third time in twenty-six years the light had failed just in the busy Christmas season. The Post Office shared in the general inconvenience. Without warning, all the departments were thrown into darkness. At first it was considered that only a slight stoppage had occurred; but when a few minutes had passed, and no light had reappeared, the matter became serious. All the lamps available were brought into use, and assistants were dispatched to procure candles. In the faint glimmer of candle-light, the business was carried on as expeditiously as possible. At the Town Hall, candles were resorted to.

The electricity supply undertaking at Dundalk has not had an untroubled existence since the works were started last June. There was a failure of light for half-an-hour last Wednesday night; and this was the second accident of the kind.

An offer has been made by the Chichester Corporation to the Westbourne Rural District Council to lay water-mains for supplying Bosham (Sussex), provided a guarantee of 10 per cent. on the outlay is assured. The cost of a 4-inch main up to a certain point, and the remainder a 3-inch main, will be £800; but if a 3-inch main throughout is accepted the cost will be £700. It is feared, however, that in cases of fire the latter would not prove effective. A Special Sub-Committee is to report on the matter.

UNPROFITABLE ELECTRICITY SUPPLY AT WOOLWICH.

Further Borrowing Sanctioned.

A long debate took place at the meeting of the London County Council last Tuesday on a report presented by the Finance Committee on the subject of an application by the Woolwich Borough Council for sanction to the borrowing of money for the extension of the electricity undertaking. In the course of their report, the Committee furnished the following particulars.

On March 7, 1912, the Woolwich Borough Council applied to the County Council for sanction to the borrowing of £36,570 for the purposes of the electricity undertaking, to enable it to meet further demands. In view of the large extension of plant proposed, and the unsatisfactory financial results hitherto realized by the undertaking, the Committee suggested to the Borough Council that they should have expert advice on the undertaking generally. They accordingly obtained a report from a consulting engineer, who, after considering various methods by which the additional energy required could be provided, advised the Council to abandon one of the generating stations – viz., that at Plumstead—altogether, and extend the other station, at Globe Lane, Woolwich, to enable them to deal with the total output from the latter station. The present loss on the undertaking (after meeting all loan charges) is about £16,000 a year; and the engineer estimated that by the adoption of the scheme he recommended, the loss would be reduced to about £9561. He based his estimates on the extra efficiency of up-to-date machinery. The Council decided to accept this advice, and accordingly made an amended application for sanction to the borrowing of £50,000, and for an advance of £20,000 to cover the cost of urgent works.

Subsequently, after conference with the consulting engineer, the Council decided to remove certain machinery and plant from the Plumstead station to the Globe Lane station—thus avoiding the purchase of certain new plant and machinery provided for in the original scheme; and they proposed to alter and bring up to date the boilers to be removed, and charge the cost to revenue account. As the result of this modification, they reduced from £50,000 to £40,000 the amount for which sanction to a loan was desired.

Among the other schemes considered by the consulting engineer was a proposal for taking a partial bulk supply, supplemented by a supply from the Globe Lane power-house. This scheme involved capital expenditure of only £16,330, and was considered by the engineer to be an economial one. On the whole, however, he advised the extension of the Globe Lane station. The Committee were advised that under the partial bulk supply scheme, the present loss on the undertaking would be reduced to about £9890. It would be seen, therefore, that, even if the estimates of saving were fully realized, as to which there was considerable doubt, the scheme proposed by the Council was only slightly more favourable, from a financial point of

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view, than the partial bulk supply scheme, while it had the great disadvantage of involving a much larger capital expenditure. The need for an increased output, in order to enable the Council adequately to meet their obligations in the matter of electricity supply was admitted; but, having regard to all the circumstances of the case and the financial conditions of the undertaking, the Committee considered that there was a very strong case in favour of limiting any further capital outlay at the present time. They, therefore, inquired very carefully into the comparative merits, from the financial point of view, of the two schemes referred to.

After prolonged consideration of the case, the Committee suggested to the Borough Council that, in the financial interests of the undertaking, it would be preferable to adopt the partial bulk supply scheme. The Council, however, definitely declined to adopt such a scheme. The Committee were still strongly of opinion, after having conferred with representatives of the Council, that the course they suggested would be preferable from the point of view of the ratepayers of Woolwich, in that it would avoid the heavy capital expenditure proposed; but they did not feel that the County Council could decline to sanction the application of the Borough Council on this ground. It only remained, therefore, to consider the details. The Committee explained that the amount of £40,000 applied for might be divided approximately as follows: (1) Buildings, £12,000; (2) mains, £5500; and (3) machinery and plant, £22,500. The proposals were not sufficiently advanced for the Borough Council to supply full particulars, and the Committee were therefore unable to deal finally with the total amount required. The Council stated, however, that it was extremely important that there should be no delay in the matter, as otherwise they will not be in a position properly to fulfil their obligations in the matter of electricity supply. The Committee therefore thought sanction should be given to the borrowing of an amount on account. They were advised that as regards buildings a sum of £4000 on account might be sanctioned for a period of thirty years, which was within the life of the works, and that the following amounts might be sanctioned on account for engineering works: Mains, £5000; plant and machinery, £10,000. The periods of repayment now allowed for these purposes were twenty-five and fifteen years respectively; and the Committee were advised there was no objection to these periods being granted in the present case. They recommended that the borrowing by the Borough Council of an amount not exceeding £19,000 for their electricity undertaking be sanctioned on the conditions named.

In the course of the debate, it was urged that by sanctioning the loan the County Council would be bolstering up a thoroughly bad business venture at the expense of the ratepayers. The time had come when the London electricity supply problem should be settled, and so avoid letting the municipal undertakings get into a further deplorable financial condition. As the County Council and the Borough Councils did not appear to be able to deal with the problem on a satisfactory basis, it seemed time that private enterprise stepped in and relieved them of the burden, not only to their advantage, but also to that of the ratepayers, who had hitherto been called upon to find the capital for these unprofitable undertakings. A motion was made that the recommendation should be referred back to the Committee; but it was lost.

NATURAL GAS IN THE UNITED STATES.

Statistics from Government Reports.

According to reports issued by the United States Government, $74,000,000 was the value of the natural gas produced in the country for the year 1911. While there was a decrease in quantity from the output of 1910 (the figures for the two years being 509,155,309,000 and 508,353,241,000 cubic feet), the value of the production in 1911 was nearly $4,000,000 greater than that of 1910—a gain of 4·76 per cent. The increase in demand for natural gas from consumers of all kinds, according to the United States Geological Survey, in a report on the production of natural gas in 1911, makes the supply of gas a matter of growing seriousness. Beyond question the natural gas that can be furnished in many of the fields of the States is simply a function of the capital invested in natural gas lines, and especially in power plants for pumping the gas. But the safety of such large investments decreases in proportion as the unsatisfied demand becomes indicative of a failing supply.

In Ohio and Indiana, the yield has diminished so rapidly as to stop the investment of the further capital necessary to increase production. One important feature bearing on the production of natural gas during 1911 was the excessive demand for it in Kansas City (Mo.). This caused a Board of Public Utilities to create a Commission headed by Mr. Erasmus Haworth, the State Geologist of Kansas, to investigate the probable duration of the supply. In his report, Mr. Haworth expresses the opinion that a supply of natural gas sufficient for the needs of the city is not possible for longer than three or four years. It may be remembered that it was stated in the "JOURNAL" for the 8th of October that, in order to conserve the gas, all industrial manufacturing works which had hitherto used it had been required to discontinue the practice, and to change either to coal or oil. It was intended to husband the gas for domestic use; and the Company who control its supply not only took the step mentioned, but simultaneously increased their price from 1s. 3d. to 2s. 1d. per 1000 cubic feet.

Pennsylvania was the greatest consumer of natural gas last year, with an output of 154,475,376,000 cubic feet; Ohio was second, with 112,123,029,000 cubic feet; West Virginia was third, with 80,868,645,000 cubic feet; and Kansas fourth, with 77,861,143,000 cubic feet. The Kansas figure includes gas piped from Kansas and consumed in Missouri, also gas piped from Oklahoma into Kansas and Missouri. Pennsylvania used last year 103,227,580,000 cubic feet for manufacturing and 10,221,153,000 cubic feet for other industrial purposes, power, &c.; West Virginia used 50,130,046,000 cubic feet for manufacturing

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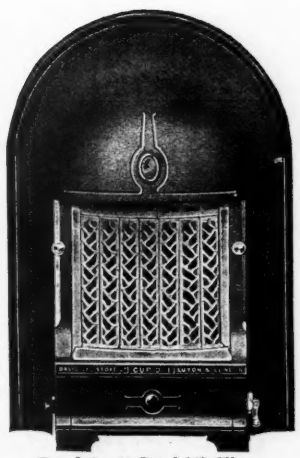

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and 16,868,278,000 cubic feet for other industrial purposes; and Kansas used 46,570,417,000 cubic feet and 3,602,355,000 cubic feet for manufacturing and other industrial purposes respectively.

On Dec. 31, 1911, there were 10,809 productive wells in Pennsylvania, 4755 in West Virginia, 4717 in Ohio, 2633 in Indiana, and 2004 in Kansas. The total number of productive wells in the United States on that date was 28,428.

During the last three years, the separation of the more volatile grades of gasoline from natural gas issuing from oil wells has become a profitable industry of increasing importance; but it did not progress so rapidly in 1911 as was expected. It is considered that it will undoubtedly eventually become a settled and flourishing business, for millions of cubic feet of gas that are now wasted on leases might be converted into gasoline if the demand and price should warrant it. The United States Geological Survey last year attempted to compile figures of production of gasoline from natural gas; but many plants were operated intermittently, and no records were kept of the output. Statements from such producers could only be estimated. However crude the method of manufacture, a report of the quantity of gasoline produced shows an output last year of 7,425,839 gallons, with an estimated value of $531,704.

WATER-WORKS EXTENSIONS IN BELGIUM.

According to some particulars given in the Engineering Supplement to "The Times," an important stage in the scheme undertaken by the Brussels Intercommunal Water Company for supplying a number of communes in Flanders with water collected from the Houyoux River, near Modave, is represented by the construction of two new sections of the conduit from Modave to Mazy, for which tenders are being invited. The works for the first section include an aqueduct about 10,600 yards long, of which about 8300 yards are to be in tunnel between Landenne on the Meuse and Gelbressée, while the other section consists of 9360 yards of aqueduct, of which about 2500 yards are to be built in tunnel between Rhisnes and Mazy, where the conduit conveying the water collected from the Houyoux will join the present aqueduct supplying the Brussels district with water from the Bocq River in the Namur province. The total cost is estimated at 2,100,000 frs. (£84,000); and according to the specification the works are to be completed within 40 and 30 months respectively for the two sections. The five sections forming the conduit from Modave to Mazy have a total length of about 30 miles; and there only remains to be awarded the contract for the aqueducts between the syphon under the Meuse and Landenne.

Additions representing an expenditure of nearly 1,000,000 frs. are to be made to the water-works owned at Waelhelm by the Company who supply Antwerp with water from the River Nethe (nearly 12 miles distant); and it is proposed to lay a second conduit about 3½ miles long as an additional means for supplying the town of Mons with water collected from springs near Spiennes. A scheme is projected to provide Louvroil (in the Erquelinnes district), on the Sambre, with water-works plant at an estimated cost of 320,000 frs. (£12,800).

Generally speaking, works of water supply in Belgium are initiated by the communes. Scarcely one-tenth of the 2600 Belgian communes are provided with works for supplying drinking water, and in most cases the plants are independent of each other. To cope with the inconveniences entailed by this condition of affairs, the Government has introduced a Bill for establishing a Société Nationale des Distributions d'Eau, the function of which will be to inquire into the needs of the different communes, to investigate the available sources of supply, and to carry out the works required in each case. This organization is to be on the same basis as the Société Nationale des Chemins de Fer Vicinaux, which has in hand almost the whole system of light railways in Belgium. The capital is to be provided by the State, the provinces, and the communes interested; and it is estimated that 200,000,000 frs. (£8,000,000) will be required for carrying out the necessary works.

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

Edinburgh.—At Tuesday's meeting of the Town Council, the recommendation by the Cleaning and Lighting Committee, to the effect that Mr. John Gibson, the Assistant-Inspector, should be promoted to the head of the department, at a salary of £400 per annum rising by increments of £25 to £500, was adopted. Mr. Mackay, the present Inspector, retires on Jan. 15, under the terms of the Superannuation Act. The appointment was not made without some discussion as to whether the Cleaning and Lighting Department should not be amalgamated with that of the Burgh Engineer, so as to pave the way for the whole of the departments of the city being under the control of a general administrator. It was, however, indicated in the course of the discussion that such a proposal was not practicable, and the trend of the opinion of the members of the Town Council, as revealed in the course of the debate, was strongly in favour of continuing the old arrangement. It was mentioned that Mr. Gibson had been 25 years in the city's employment, and that he was one of the most capable and efficient employees. In the end, the proposal to delay the appointment was withdrawn, and Mr. Gibson's retention for the post of Inspector was made a unanimous one.

Aberdeen.—The Gas Committee have had before them a report submitted by the Gas Engineer on the subject of the provision of additional carbonizing plant at the gas-works, together with the relative plans. From the report it appeared that, in order to meet the increasing demands for gas, it would be necessary to fit up an installation of retorts capable of producing a million cubic feet of gas per

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diem, and that, in the opinion of the Engineer, the most suitable type of retort for the purpose was that constructed on the vertical system. The Committee approved of the report, and resolved to recommend that an installation of vertical retorts should be fitted up as suggested by the Gas Engineer; the cost, including coal-handling plant complete, being estimated at £18,500.

Dundee.—A millworker named James M'Kee was ordered on Tuesday by Sheriff Neish to pay a fine of 10s., or suffer ten days' imprisonment, for attempting to open a prepayment gas-meter.

Dunfermline.—The Gas Committee have considered the question of supplying gas-fires to consumers. The Council have resolved to supply them at 50 per cent. less than the list prices, and to fit them free of charge, as at present. A rebuke was administered to the Provost and Magistrates at a sitting of the Dean of Guild Court last Tuesday. Plans were presented on their behalf for a hoist tower—a brick building about 60 feet in height—erected within the ground belonging to the Corporation Gas Department. The Burgh Surveyor reported that the plans were satisfactory, and, answering Dean of Guild Henny, said he had nothing more to add. The Dean, however, demanded to know why plans were now put before the Court asking authority to construct a building which was actually almost entirely completed. Mr. R. T. Milne, the Deputy Town Clerk, on behalf of the petitioners, explained that they had, until receiving further legal opinion, been in the belief that the Gas Act gave them authority to erect such a building within their own ground without asking the sanction of the Court. After discussion, the Dean said that a very grave contravention of the Court bye-laws had been committed, and he warned the Magistrates (represented by the Gas Committee at the Court) against committing a similar breach of the regulations.

Peterhead.—An entirely new Gas Committee has been appointed at Peterhead, with Mr. James Gordon as Convener.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Dec.* 20.

Sulphate of Ammonia.

Although no further advance in prices has to be recorded for near delivery, the market for this material has continued very firm throughout the week, and all available supplies have been readily disposed of at full values. The shipments in November to the United States proved to be much heavier than had been generally expected, and the requirements to cover contracts with buyers on the other side of the Atlantic have also been large in December. The closing quotations remain £14 5s. per ton f.o.b. Hull, £14 6s. 3d. per ton f.o.b. Liverpool; and £14 7s. 6d. per ton f.o.b. Leith. There has not been much new business reported in the forward position, but it has transpired that £14 12s. 6d. per ton f.o.b. at the ports has been realized by manufacturers for January-June delivery in equal monthly quantities.

Nitrate of Soda.

There is again no change in the situation of this article, and holders maintain prices at 11s. 7½d. per cwt. for ordinary and 11s. 9d. for refined quality, on spot.

LONDON, *Dec.* 20.

Tar Products.

The markets for tar products are very inactive at the present moment, though the prices of several articles are fairly firm. Pitch is a little steadier, though there is not a large amount of business doing. Benzols are decidedly quiet; and low prices are reported to have been taken in some quarters for prompt delivery. Solvent naphtha is inactive; and there are not many buyers in the market at the present moment. Heavy naphtha is steady; but business is quiet. Creosote remains firm; and the inquiry continues good for near and forward delivery. Crude carbolic is still in the same unsatisfactory state.

The average values during the week were: Tar, 27s. 3d. to 31s. 3d. Pitch, London, 43s. 6d. to 44s.; east coast, 43s. 6d. to 44s.; west coast, Clyde, 44s. to 44s. 6d.; Manchester, 41s. to 42s.; Liverpool, 41s. 6d. to 42s. 6d. Benzol, 90 per cent., naked, London, 10½d. to 11d.; North, 9½d. to 10d.; 50-90 per cent., naked, London, 10½d. to 11d.; North, 10d. to 10½d. Toluol, naked, London, 11d.; North, 10½d. Crude naphtha, in bulk, London, 5½d. to 5⅝d.; North, 5d. to 5¼d. Solvent naphtha, naked, London, 1s. 1d. to 1s. 1½d.; North, 1s. 1d. f.o.b. Heavy naphtha, naked, London, 11½d. to 1s. f.o.b.; North, 10½d. to 11d. f.o.b. Creosote, in bulk, London, 3⅛d. to 3¼d.; North, 3d. to 3¼d. Heavy oils, in bulk, 3⅜d. to 3½d. Carbolic acid, casks included, 60 per cent., prompt, east and west coasts, 2s. 3d. to 2s. 4d.; forward, 2s. to 2s. 1d. nominal. Naphthalene, £5 to £9; salts, 45s. to 50s., bags included. Anthracene, "A" quality, 1½d. to 1⅝d. per unit, packages included and delivered.

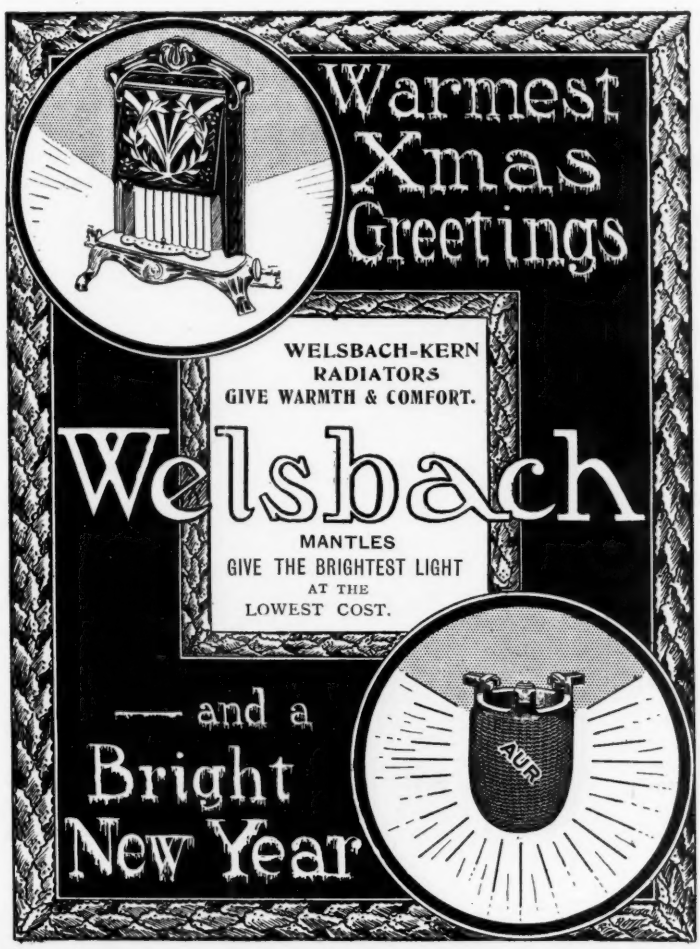
Sulphate of Ammonia.

There has been a further improvement in the market for this article. The inquiry has been decidedly better; and contracts are reported in many quarters at the increased prices. Outside London makes are £13 7s. 6d. to £13 8s. 9d.; Hull, £14 5s.; Leith, £14 5s. to £14 6s. 3d.; Liverpool, £14 5s.; and Middlesbrough, £14 3s. 9d. to £14 5s.

COAL TRADE REPORTS.

Northern Coal Trade.

There is now very great activity in the coal trade of the North, and deliveries are full, so as to make up for the loss during the period of the strike. As so much of the delivery is on contract, prices are rather irregular. In the steam coal trade, best Northumbrians are from 15s. to 15s. 3d. per ton f.o.b., second-class steams are from 14s., and steam smalls are still relatively high at about 11s. There is now naturally



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a very full demand for gas coals, for the consumption is at its heaviest, and the great users wish to add to their stock for the holiday needs. Best Durham gas coals are about 16s. per ton f.o.b., and up to 16s. 3d., second-class gas qualities are about 15s., and "Wear" specials are from 16s. 6d. Now that the arrivals of steamers are better at the coal ports, there are heavy shipments of gas coals being made; but there is not much free for sale early, as contract quantities take up most of the production. Occasional cargoes, too, command high prices, though the carriage of gas coals to ports on the Mediterranean is very much lower than it was about six weeks ago. Coke is very firm. The large output of gas coke is well taken up, with some variation in the price; good makes being from 21s. to 22s. per ton f.o.b. in the Tyne.

Scotch Coal Trade.

There is great activity in all departments of the coal trade in Scotland, and the outputs from the various collieries are practically booked up to the end of the year. On Thursday, the prices quoted on the Glasgow Coal Exchange were approximately: Steam coal, 13s. 6d. to 14s. per ton f.o.b. Glasgow; splint, 14s. to 14s. 6d.; ell, 13s. 6d. to 13s. 9d.; trebles, 13s. 3d. to 13s. 6d.; doubles, 12s. 9d. to 13s.; and singles, 11s. 9d. to 12s.

GAS COMPANIES' STOCKS AND SHARES.

The Stock Exchange (as was only to be expected) had but a quiet time of it last week. Not only on account of the imminence of the holidays, but because the general condition of affairs both at home and abroad was not such as to encourage launching out into the unknown. Peace negotiations found themselves hung-up as soon as they started; and the remarkable proceedings taken to suppress the Gateshead labour trouble are apparently not the last we shall hear about industrial questions in the near future. The hardening of money was another steadying factor. However, after a dip down in the middle of the week, things lifted their heads again; and the close was fairly cheerful. The tone at the opening on Monday was quite hopeful and promising; but its strength gave way as the day went on, partly owing to the weakness in foreign bourses. Government issues receded. Consols lost ⅛, Rails were listless, and Americans fell. Business was very slack on Tuesday. Consols lived through it without loss; but Rails were depressed. Americans were put up by Wall Street; and Foreign had one or two good points. On Wednesday, the tendency was depressed on the same doubts and fears as to foreign affairs, in addition to the hardening of money. Gilt-edged descriptions were hit; and Consols fell ⅛. Rails moved fitfully up and down; and Americans were quite flat. A change appeared on Thursday—signs and tokens in the international atmosphere being regarded as propitious, strengthened by the non-advance of the Bank rate. Almost all markets improved. Consols regained ⅛, Rails were bright and advanced their prices, and Americans had some good points. The better tendency was continued next day in all the chief departments; and Consols had a smart jump of another ⅛. In the Money Market, there was a strong demand, and discount tightened steadily; but, to the general relief, the Bank rate was not raised. Business in the Gas Market was a bit more brisk than the week before. But few quotations moved at all, and they irregularly. In Gaslight and Coke issues, the ordinary was active and firm, and changed hands at prices ranging from 105⅝ to 106¼. In the secured issues, the maximum made 83½, the preference 100¼ and 101⅛, and the debenture 76¼ and 76⅜. In South Metropolitans, the price was a point easier, transactions showing figures from 116¼ to 117⅜. The debenture made from 77⅛ to 78½. In Commercials, the 4 per cent. was done at 108, and the debenture at 72⅜. Among the Suburban and Provincial group, Bournemouth "B" realized 16⅛, Lea Bridge 123½ and 124, South Suburban 120, Tottenham "B" 117, and Wandsworth 140 and 141½. In the Continental companies, Imperial changed hands at 176 to 177 (a fall of 1), and Union at 85¼ to 86¼. Among the undertakings of the remoter world, Bombay was done at 6¾ (a rise of ⅛), Cape Town debenture at 70¼ (a rise of 3½) Monte Video at 12⅛ to 12⅜, a small lot of Oriental at 126, and Primitiva at 6⅞ and 6⅝.

Kidderminster and the Water Supply of Stourport.—The Kidderminster Water Committee have decided to make a proposal to supply water to Stourport at a flat-rate of 5d. per 1000 gallons. This is still not so favourable as the offer of the Bewdley Corporation, which the Stourport Council accepted. The Kidderminster Council have hitherto declined to reduce the figure of 6d. per 1000 gallons up to 20 million gallons, and 5d. for any amount over this quantity which they have been receiving from Stourport for 33 years. A Local Government Board inquiry was held last week relative to the application of the Stourport Council to borrow £1400 to carry out the agreement for obtaining a supply from Bewdley. The Kidderminster Council then opposed the application.

Tottenham District Council and the Gas Company.—At the meeting of the Tottenham District Council last Tuesday, a letter was received from the Tottenham and Edmonton Gas Company stating that, notwithstanding that their contract with the Council for street lighting did not expire until next June, they proposed to reduce the charge as from the 1st prox. Mr. Harvey said it would be interesting to know why this reduction was being made, and whether the Council could not ask the Company to consider the price charged for gas to the ordinary consumer. He inquired if the Council had a right to oppose the Bill which was being promoted by the Company to acquire the Enfield Gas Company's undertaking and to obtain the transfer of the Wood Green District Council's Electric Lighting Order. The Clerk replied that they could do so. Mr. Harvey proposed that the Solicitor should be instructed to take the necessary steps to oppose the Bill, in order to give the Council *locus standi*. Mr. Beales seconded the motion, and it was carried.

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Domestic Dangers of Electricity.

An inquest was held at Erdington, Warwickshire, early last week, concerning the death of a youth fourteen years of age, named William Howard Rymond, who was electrocuted in his bath when experimenting with electricity. On the night of the 13th inst. he went upstairs to have a bath. He had been experimenting with an electric battery which had been bought for him as a Christmas present. It was not known, however, that he had connected it with the electrical current by which his parents' house was lighted. Jervis Rymond said he found his brother dead in the bath, and when he took hold of his hand to get him out he received an electric shock. There was a wire connected with the electric light switch in the bath, as well as one from the dry-cell battery. Mr. R. A. Chattock, Electricity Engineer to the Birmingham Corporation, said that when the wires were connected in the manner described a current of 230 volts would pass through the water in the bath to the earth—the down pipe acting as a down wire. It would be multiplied at the two electrodes which were connected with the secondary winding of the coil on the battery. The Jury returned a verdict of "Accidental death."

Mond Gas for Electricity.

In moving the adoption of the report—noticed in the "JOURNAL" for the 10th inst., p. 863—at the meeting of the Power-Gas Corporation, Limited, the Chairman (Sir Alfred Mond, Bart., M.P.), alluded at some length to the various industrial operations in connection with which power gas is now used. He said that as far as both the general engineering branch and the power gas branch of the business were concerned, he thought there was every reason to be satisfied with the progress made. Though it was now a great many years since the first central electric supply station in Northwich began to distribute electricity manufactured by Mond gas furnished by Messrs. Brunner, Mond, and Co., public authorities, in spite of the fact that it had been the cheapest electric supply of any public authority in the country, were somewhat slow in adopting the newest and cheapest method of producing power. The Wednesbury Corporation, who were on the gas system of the South Staffordshire Mond Gas Company, were to-day distributing about 1500 H.P. in the form of electricity made from Mond gas; and they had never had the slightest difficulty since they started. This year, the Corporation had erected a plant at a municipal station in Lancashire, which had just been successfully started, of 2000 H.P., with ammonia recovery, for their electricity work. The interest of this station was that they had had the courage immediately to put up 2000 B.H.P. "National" gas-engines.

Gas Charges at Soothill.—There is some agitation in the Soothill Ward of Batley over the charge for gas, which it is held has been fixed at a higher rate than should have been the case under the arrangement made at the time the area was annexed by Batley under an Extension Order. Since the passing of the Order, it seems, the price of gas has been raised from 2s. 1d. to 2s. 7d. per 1000 cubic feet. Alderman Simpson wrote to the Local Government Board calling attention to the alleged breach of faith; and the Board forwarded a copy to the Batley Corporation, with a request for their observations upon it. The majority of the Corporation, it is reported, hold that Batley can impose on Soothill whatever gas charges are made in Batley proper, though it is disputed whether this can be done in order to extract from the added area contributions to be used to liquidate a deficit in the general revenue account. It is pointed out that the Corporation have had to pay 2s. per ton more for coal since the strike. At public meetings in Soothill resolutions have been submitted protesting against the Corporation increasing the price of gas in the Soothill area for the exclusive benefit of Batley rates.

Fermoy Council and the Gas Company.—At a recent meeting of the Fermoy (Co. Cork) Urban District Council, Mr. Troy, the Council's Solicitor, drew attention to the accounts furnished by the Gas Company, and said there was no statement in them of profits derived from the sale of coal and fittings, while he commented on the extraordinarily low product of gas. He reminded the Council that in the evidence of Mr. Spencer at a recent inquiry, it was proved that 10,000 cubic feet of gas should be obtained from a ton of coal. The Gas Company, however, only showed 6000 cubic feet, or a little more. There was very little information in the balance-sheet; but a remedy for this was provided by Statute. The Council had no power to look at the Company's books; but an individual could do so. If the people saw that they were getting a benefit from the profits on the sale of coal and fittings, they would feel more inclined to support the Company; and, in his opinion, they would be supported in a better way if the price of gas were reduced. When the Gas Company had the contract for the supply of gas to the barracks, they were able to give it at 3s. 1d. per 1000 cubic feet. It was ultimately decided to leave in the hands of the Chairman and Mr. Troy the questions which had been raised.

School Lighting Question at Croydon.—At the last meeting of the Croydon Education Committee, a report from the General Purposes Committee was considered, recommending the expenditure of £954, in addition to the ordinary estimates, for improving the artificial lighting in ten schools by abolishing the present flat-flame burners and adopting electric light. Mr. Newnham moved, as an amendment, that the recommendation be referred back. It would, he said, cost only £87 to light the schools satisfactorily by incandescent gas. Mr. West said these remarks were somewhat misleading. The £87 was only for converting the flat-flame into incandescent burners; but the Gas Company said this would be very unsatisfactory. Incandescent gas required special burners, and the cost of properly equipping the schools would be upwards of £1000, which put a very different complexion on the matter. Miss Marshall remarked that at the Parish Church Schools a change was made from flat-flame to incandescent burners, and the cost was very small. Mr. Wood Roberts supported the amendment, and suggested that they should try incandescent gas lighting in one of the schools, by way of experiment. Mr. Bayliss said he was under the impression that gaslight was better for the eyes of children than electric light. The amendment was carried by 13 votes to 9.

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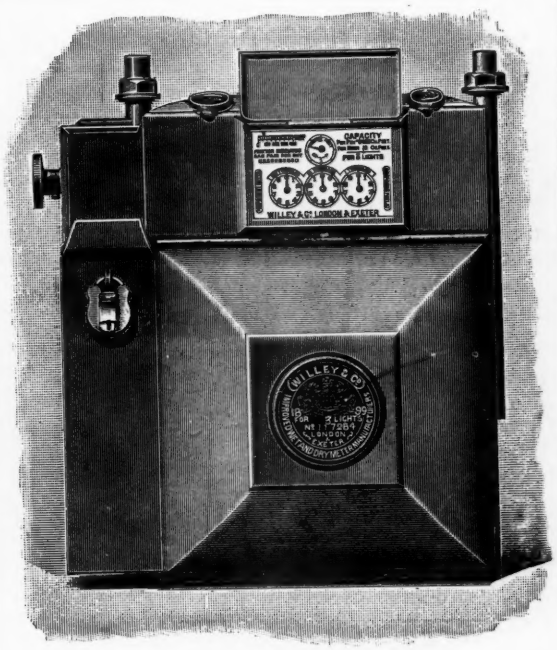

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The Welsbach Light Company, Limited, of Gray's Inn Road, London, W.C., announce the appointment of Mr. B. Cars as their Managing-Director, as from Jan. 1, 1913.

The Local Government Board have acceded to the request of the Heywood Corporation to sanction an equated period of 22 years in respect of borrowing powers for the new carbonizing plant.

A Sub-Committee has been appointed by the Gas Committee of the Stalybridge Town Council to consider and report upon the question of extending the area of gas supply so as to include the urban district of Mottram-in-Longdendale.

Lecturing recently at Rothesay on the subject of "The Necessity for a Purer Atmosphere," Bailie W. B. Smith, of Glasgow, said smokeless methods of heating and cooking were now practicable. In almost every village gas was provided for the houses, and, if carefully used, the price compared favourably with that of coal. He was convinced that in a few years the process of gas making would be so improved that the price would be lowered, and a smokeless bye-product better than ordinary coke would be made that could be burned in the old-fashioned grates without producing any smoke.

Interruption in the supply of electric current for lighting purposes in Belfast caused some inconvenience on Sunday, the 15th inst. The most serious trouble arose owing to a short-circuit in a main near the centre of the city.

At the London Bankruptcy Court on Friday, before Mr. Registrar Brougham, an application was made for the discharge of Jerome Walter May, trading as J. W. May and Co , importer of gas-lighting specialities, of No. 33, Cock Lane, Snow Hill, E.C. Mr. W. T. Bowyer, who attended as Official Receiver, reported that the receiving order was made on Oct. 11, 1911. The statement of affairs filed by the debtor showed liabilities expected to rank against the estate for dividend amounting to £8725; but the Trustee reported that proofs had been admitted for £9278. The Trustee further reported that the assets, which in the statement of affairs were estimated to produce £1085, had only realized £540. After a long discussion, the Registrar adjourned the matter until the end of January, in order that the debtor might be able to ascertain whether his friends would consent to hand the Official Receiver £250. If this were done, the Registrar said he should feel disposed to grant the debtor an immediate discharge.

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